OSBORN

A Local study of Hibernation in insects

Entomology

A. M.

1910

UNIV. OF
ILLINOIS
LIBRARY

UNIVERSITY OF ILLINOIS
LIBRARY

Class 1910
Book O51
Volume

Mr10-20M

A LOCAL STUDY OF HIBERNATION IN INSECTS

870
[illegible]

BY

HERBERT TIRRILL OSBORN
A. B. Ohio State University, 1909

THESIS

Submitted in Partial Fulfillment of the Requirements for the

Degree of

MASTER OF ARTS

IN ENTOMOLOGY

IN

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1910

1910
O51

1910

22N10 Craig

UNIVERSITY OF ILLINOIS

THE GRADUATE SCHOOL

June 3, 1910 190

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Herbert Tirrill Osborn, A.B.

ENTITLED A Local Study of Hibernation in Insects

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Master of Arts in Entomology

S. A. Forbes
In Charge of Major Work

S. A. Forbes
Head of Department

Recommendation concurred in:

Committee
on
Final Examination

167939

Digitized by the Internet Archive
in 2013

http://archive.org/details/localstudyofhibe00osbo

A LOCAL STUDY OF HIBERNATION IN INSECTS.

Introduction.

Hibernation in insects relates to their existence in winter. This is an important phase of their life history; and a study of hibernation includes all those adaptations by which their winter existence is assured. The more important items of such a study are,-the preparation of insects for hibernation; the time of their entrance into it, of their continuance in it, and of their emergence from it; the means by which they withstand the temperatures and climatic conditions to which they are exposed; and the protection in which the winter is passed.

The first part of this paper is a discussion of the subject based largely on the literature of the general phenomena of hibernation, such as the physiological effects of hibernation, the temperature limits of insect life and the various problems which arise in connection with a study of the subject. In the second part are given the observations made during the present season at Urbana on the species to be found during winter on headlands and other waste patches of that nature.

The Phenomena of Hibernation.

All of the stages of insect life may be found during hibernation. Two of these stages, the egg and the pupa, are normally inactive and do not require food. Hibernation is simpler for them in that they have merely to resist the effects of temperature and to be concealed from enemies. In the larva and adult, however, all

of the functions of active life might normally be expected, but are obviously impossible at winter temperatures. For a period varying widely with different species a state of torpidity is assumed in which often all activities apparently cease.

The physiological changes connected with hibernation are still subjects of discussion, it being asserted, on the one hand, that once the body fluids freeze an insect cannot recover, while on the other hand various experiments are on record which seem to show that actual freezing has taken place without ill results.

As early as 1879 Miss Ormerod made some observations in England on the effect of a low temperature on insect larvae. Of the species which she collected in a frozen state, almost all of the individuals revived on being warmed up. Of eighty larvae of the cabbage and turnip gall weevil examined, all except one revived on being kept in a living-room, although they had been subjected continuously to cold weather which reached as low as 10° F.

More interesting is the statement of H. H. Lyman concerning the effect of temperature on arctic insects. Commander James Ross on an arctic voyage, subjected thirty larvae of Laria rossii alternately to extreme arctic cold and to the heat of a living-room. In September they were placed in a box, and they were then exposed to the winter for three months. They were then brought into a warm cabin, where in less than two hours all became active and remained so for a whole day. They were then reëxposed to a temperature of 40° below zero, and became immediately frozen, and were left in this state for a week. This time, on being brought into a warm room, only twenty-three revived. At the end of four hours these

were again frozen hard for a week after which time only eleven survived. Upon a fourth exposure to winter temperature only two revived and these two lived through the winter, one completing its life cycle and producing an imperfect adult; while from the other, six parasitic flies were reared.

The discussion by Davenport, in his Experimental Morphology, on the physiological changes involved in hibernation, and on minimum temperatures, helps to clear up many questions concerning insect life during winter. A reduction of the temperature causes a diminution of metabolism until a point is reached at which metabolic activity ceases. This is not death, but a condition which Davenport calls temporary rigor. Death occurs at a few degrees beyond this point of temporary rigor. Toward the lower limits, -40° C to -50° C, molecular changes are slow and principally confined to the change from the liquid or the gaseous state to the solid. This change occurs in the water of the protoplasm, but the colloids which constitute the living part are not modified by even the lowest terrestrial temperatures, except that the molecular changes which they undergo are very slow. Under certain conditions then - principally the absence of water - protoplasm may resist the lowest temperatures uninjured. Few of the chemical changes of metabolism take place below 0° C. Death, when due to cold in simple organisms, is attributed to excessive irritation, mechanical rupture, and perhaps other causes, the effect being principally mechanical, involving the water of the body. A few of the barely fatal temperatures which have been determined for insects are as follows:-

Apis mellifica......-1.5° C for 210 minutes.......Roedel '86.
Lema sp............-6° C for 30 minutes..........Roedel '86
Phytonomus sp.......-12° C for 90 minutes.........Roedel '86
Vanessa io, larvae..-17° C for 120 minutes........Pouchet '66

It may be seen from these few examples that the critical point varies widely in different insects. It is not stated whether the above experiments were performed on hibernating insects, although apparently they were not.

Another point brought out by Davenport is the acclimatization of insects to cold. There are certain insects (for instance Desoria glacialis, the Glacier Flea of the Swiss Alps, Podura hiemalis, and Trichocera brumalis) which are active on snow and ice. From these facts Davenport concludes that protoplasm may be so modified by the action of excessive heat or cold that it is no longer killed at temperatures ordinarily fatal. This is partly due to the fact that it is not then so strongly irritated by these extreme temperatures and partly to the fact that the coagulation and freezing points have been shifted, possibly as a consequence of loss of water.

The effect of temperature on insect life has been recently more extensively studied by Bachmetjew, but his conclusions are essentially similar to those of Davenport.

Preparation for and emergence from hibernation.

In connection with the physiological effects of low temperatures, the changes preparatory to hibernation may well be considered. So far as known to me this feature has only been studied in detail by Tower, and by him in but one insect, the Colorado

potato beetle. After the second brood emerges a large amount of food is devoured and stored up in the fat body as a reserve supply. The beetle then stops feeding and prepares for hibernation by emptying the alimentary canal of all food and by the elimination, through the Malpighian tubules, of waste products. The gross weight of the insect is thus reduced 30%,- 3% by the ejection of waste products and 27% by the removal of watery matters by the excretory organs and by evaporation from the body surface. Tower regards the preparation for hibernation as largely a reduction of the watery content and a consequent lowering of the freezing point of the tissues,- a view which agrees with Davenport's conclusions cited above.

On emergence from hibernation, Tower's beetles weighed less, in both net dry and gross weights, than when hibernation began,- a fact which shows that a low grade of metabolism had been maintained during the winter. The physiological changes on emergence from hibernation are similar to those taking place on entrance into it, but occur in reverse order.

Many insects must encounter winter conditions much more severe than those endured by the Colorado potato beetle, which hibernates underground at a depth of 18 inches to 2 feet. No careful study of a similar nature on any insect which hibernates above ground is available at present.

The Cause of Hibernation.

Temperature is usually considered to be the immediate cause of hibernation in most insects. Hunter and Hinds, in their study of the Cotton boll weevil, found such to be the case with that

insect. The entrance into hibernation was a gradual process, involving little preparation. The weevils were active on warm days and inactive on cold days, until a temperature was reached at which activity ceased.

There are, however, many facts which seem to show that other factors enter into the preparation for, and entrance into hibernation, by many forms of insect life.

During the fall many of the insects found along headlands were extremely active on warm days and inactive on cool days, during which they were secreted under matted grass. Some were inactive only at low temperatures throughout the winter.

On the other hand there are many forms which prepare for winter and enter the hibernating stage long before cold weather begins. Some of the cocoon spinning moths might be mentioned as familiar examples.

The Colorado potato beetle is an example of an insect which has been shown to hibernate irrespective of temperature. While entrance into hibernation with it is a gradual process, occurring in late September and early October, and while it is more or less active during the process on warm days and descends below the surface on cold days, still Tower by experimental work was unable to prevent hibernation, although it might be largely inhibited by high temperatures and moisture.

Other causes which may tend largely to stimulate entrance into the period of hibernation are lack of moisture and disappearance of the food supply.

The Utility of Hibernation.

One advantage of an inactive hibernation period is an ability

to thus exist without the usual food supply. For leaf-eating insects in particular there is, in temperate climates, an entire lack of the usual food, and at the same time, as the temperature is lower and metabolic action is diminished, the need for this supply disappears.

The particular retreat sought out by insects for the winter often serves as a protection against enemies as well as against adverse climatic conditions.

This point was illustrated by A. J. Cook in Michigan (1874). Cutworms plowed up in fall were destroyed by birds rather than by cold.

The Origin of Hibernation.

The problem of hibernation is one which has confronted all insects of temperate climates and has been solved by them in such a variety of ways that it is extremely difficlt to explain the origin or to trace the history of the particular type of hibernation characteristic of any insect. It may be said, in general, that any particular mode of hibernation is an adaptation and is subject to the laws of natural selection, and that it will continually tend to become more beneficial to the species by the constant elimination of individuals unable to withstand winter conditions.

Hibernating insects may be roughly grouped in two classes, based entirely upon habit -

First,- insects which live in habitats which require but little departure from ordinary life during the winter;

Second - insects which are forced by winter conditions either to depart widely from their summer habitat or else to maintain

their existence by some special device or protection.

For the insects of the first class hibernation is a simple matter,- the Rove beetles, which live under leaves and rotting wood are examples. They are well protected in their accustomed habitat and with the approach of winter merely become less active on cold days.

With insects of more complex habit, and especially with leaf-eating species, the problem of hibernation is more difficult. The winter may be passed in any one of the four stages, and in any one of a great variety of situations. The reason why it is passed in one instead of another is usually obscure, unless one knows the past history of the insect. It seems probable, however, that the stage which requires the least departure from the ordinary habit of the species would be the one most likely to become fixed as the stage of hibernation. It is conceivable that an insect may once have hibernated in all stages, and that all have been eliminated except those wintering in the most resistant stage. For instance, many insects are now to be found during winter in more than one stage. The army worm is known to pass the winter as larva and adult, and possibly as a pupa also.

Lochhead in pointing out the difficulty of accounting for the great variety of methods of hibernation, mentions the close connection between the problem of the origin of hibernation and the origin of metamorphosis. He was led to consider the pupa as the normal form for hibernation in the latitude of Ontario, Canada.

Weed, in an account of the hibernation of aphids, shows how their various modes of hibernation may have been brought about by natural elimination. All but one of the different types mentioned by him hibernate in the egg stage. Winter eggs are laid on the

leaves, then as a farther step on the twigs. Eggs of other species have come to be cared for by the cornfield ant, and some hibernate as adults.

Variation with latitude.

Variation of hibernation with latitude is another subject which has a bearing on a study of hibernation here. For instance, do insects of wide range, which hibernate in this region, also hibernate in tropical or sub-tropical regions?

Tower, in his study of the Chrysomelid beetles of the genus Leptinotarsa, found that a quiescent period of three to five months duration was always assumed by all the species of this genus after the second generation, irrespective of the locality, a fact which seems to show that in this genus the period of hibernation is physiologically fixed. Aestivation is the term applied to quiesence in warm and dry weather; and from his work with Leptinotarsa, Tower was led to conclude that the two terms are synonomous and that aestivation and hibernation are the same phenomenon.

Closely related to this question of the relation of hibernation to latitude, is that of the difference in any one locality of the hibernation habits of species of northern and of southern range respectively. That is, will insects of northern distribution hibernate here earlier and more completely than those of southern distribution, or the reverse? Also what will be the relative effects of a severe winter upon the two groups? The data of my studies of the present season are insufficient to throw much light on these questions. The subject of the relative effects of a severe winter has been studied by Chittenden at Washington, D.C. After the severe winter of 1898-9, insect pests of southern distri-

[illegible] the [illegible]. [illegible] seem to be cared for by the ants, and thus hibernate successfully.

VARIATION WITH LATITUDE.

Variation of hibernation with latitude is another subject which is worthy of a great deal of investigation. For instance, a species of wide range, which hibernates in this region, also likewise in tropical or sub-tropical regions.

[illegible] in his study of the Chrysomelid beetles of the genus Cryptocephalus found that a quiescent period of three to five months was always assumed by all the species of this genus after the adult generation, irrespective of the locality, a fact which seems to show that in this genus the period of hibernation is probably fixed. Aestivation is the term applied to quiescence in warm and dry weather; and from his work with Cryptocephalus he was led to conclude that the two terms are synonymous, i.e. that aestivation and hibernation are the same phenomenon.

Closely related to this question of the relation of hibernation to latitude is that of the difference in type and length of the hibernation habits of species of northern and of southern range respectively. That is, will insects of northern distribution hibernate earlier and more completely than those of southern distribution, or the reverse? Also what will be the relative effect of a severe winter upon the two groups? The data of hibernation of the present season are insufficient to throw much light on these questions. The effect of the relative climatic [illegible] has been studied by [illegible]

[illegible]

bution were very scarce at the beginning of the season, although they were later reënforced in part from the south. On the other hand, insects more common to the north were much more noticeable after this severe winter than they ordinarily were.

Observations on Hibernation.

During the fall and winter a study was made of the insects to be found along headlands, fences, and hedges. During the fall a headland beside a railroad and traction line was visited several times a week, and observations were made on the insects to be found there as winter approached. The strip extended through a flat prairie, with no trees near. It was largely grown over with blue grass, sedges, slough grass, and composite weeds, and was surrounded by cornfields. A small drainage ditch ran along one side, and on the bank of this was a wire fence almost hidden in wild sunflower plants. During the winter, collecting was extended to fence rows, hedges, and waste patches about Urbana. Collecting during the winter was a very simple matter. The trash and leaves and loose earth under fences or on waste patches were carefully searched or sifted over stiff paper, and all the insects were brought into the laboratory, if in a torpid condition, to see whether they would survive. Notes and observations are given for each species separately.

The present winter would commonly be considered as very favorable to the survival of insect life. The first cold spell occurred in the middle of October, water in puddles freezing slightly on the nights of the 12th and 13th. After this the weather was rather mild until December. December 4 was bright and warm, with many

insects flying. Immediately after this it began to grow cold, and remained cold with snow and ice on the ground until the latter part of January when a warm spell again brought out some forms of insect life. It turned freezing cold with snow, again, in February, and this condition was maintained until March. March was unusually dry and warm, The thermometer going up to 80° F. in the shade, March 24.

COLEOPTERA

Carabidae

Harpalus herbivagus, Say.

This insect is reported by Forbes (12th Report of the State Entomologist of Illinois, p. 112) as feeding largely upon vegetable matter, a few specimens examined containing as high as 90% of plant tissue, principally the fragments of seeds.

Three beetles were taken during this study, one in trash, November 13, and one under blue grass, Nov. 26. No specimens were found above ground after this until March 16.

Harpalus faunus, Say.

This beetle is commonly reported as an enemy of the Colorado potato beetle.

It apparently hibernates as a beetle underground. One was taken underground October 26, and another October 30.

Harpalus pennsylvanicus, De G.

This common beetle is frequently referred to as an enemy of destructive larvae. It is known to attack the plum curculio larva (Walsh), codling moth larva (Kellog), army worm (Lintner, 12th Report of the State Entomologist of New York), and the Rocky Mountain locust (Riley, Insect Life, Vol. 2, page 369). Forbes,

however, found that the food was about 2/3 vegetable in the specimens which he examined.

It is recorded by Chittenden as a larva underground as early as April 8 and by Blatchley in Indiana as wintering in the adult stage beneath logs in dry upland woods.

It was not seen here later than October 28, and then in trash along a fence.

Callida punctata, Lec.

Mature insects of this species were taken a few inches underground October 15 and November 3. Beetles were also found among leaves and rubbish beside a wire fence, October 30 and November 6. It was not taken later and apparently hibernates underground in this stage.

Agonoderus pallipes, De G.

In the 18th Report of the State Entomologist of Illinois (page 12-14), this insect is mentioned as especially injurious to seed corn and also as injuring the roots of the corn plant. It is said to hibernate as a beetle and to emerge early in spring, laying its eggs in the ground.

The beetles of this species were reared from pupae taken from the earth in a cornfield by Forbes in 1888. The pupae were found June 20, and a beetle emerged June 25 and two more beetles June 30. Larvae of Agonderus pallipes were also found June 20, but were not reared through to the imago.

Adults were found by me in the ground October 30, and in underbrush and rubbish October 28 and November 30. They were not found above ground during the winter, but with the warm weather of March 18 a few were taken on the wing. They were common on the wing

March 23 and that night they were swarming against the window of a lighted store in Champaign.

Pterostichus sayi, Brulle.

Only one specimen of this predaceous beetle was taken, and that, October 13, before hibernation had certainly begun.

Pterostichus permundus, Say.

This beetle is recorded by Ashmead (Insect Life, Vol. 7, page 246) as attacking cotton insects in the south. A large percentage of the food was determined by Forbes to be animal matter (12th Report of the State Entomologist of Illinois, page 110). The adult was found in a location similar to that of Pterostichus sayi, October 21.

Pterostichus femoralis, Kirby.

Blatchley found this insect as an adult during the winter, under logs and chunks of wood in Vigo County, Indiana.

Beetles were taken by me October 30 in rubbish along a fence. December 4 another beetle was taken under a block of wood in a burnt over area near a railroad. Another was found January 28, under a mass of leaves and trash along a rail fence surrounding a woodlot.

Casnonia pennsylvanica, Linn.

This beetle has been listed as an enemy of the chinch bug. (E. Longuemare, Insect Life, Vol. 1, page 286). It was reported by Fay, 1862, to hibernate as a beetle under stones at Columbus, Ohio. According to Blatchley it may be found in Vigo County, Indiana, at almost any time during the winter, especially along rail fences.

Adults were taken at Urbana under the leaves and trash in a

cemetary, March 16 and again March 24.

Anisodactylus rusticus, Say.

This partly predaceous species is reported (18th Report of the State Entomologist of Illinois, page 177) as eating into the kernels of corn in the husk. It was found hibernating as an adult by Blatchley in Indiana.

A beetle was taken here October 1, but none were found during the period of definite hibernation.

Anisodactylus harrisii, Lec.

One beetle was taken among loose leaves, October 21.

Anisodactylus lugubris, Dej.

This species was secured November 3 from under leaves in an abandoned orchard.

Galerita bicolor, Drury.

The life history of Galerita bicolor was worked out by Riley (American Entomologist, Vol. 3, page 153). The species is widely distributed east of the Rockies, and commonest in the north. It is found under rocks and logs. The larvae pupate in rotten logs in August and the imagoes hibernate in the ground to come out with warm weather in spring. Riley thinks that there are probably two generations in the south. The adult was once taken January 1 by Blatchley in Indiana.

The beetles were quite common at Urbana among the weeds and trash along fences in the late fall. They were seen above ground as late as November 25.

Clivina bipustulata, Fabr.

Adults of this species were secured April 1 under matted grass.

Brachynus cordicollis, *Dej*.

This insect was found adult under bark, March 18.

Lebia ornatus, *Say*.

One bettle of this species was taken March 5, under trash which had accumulated beside a rail fence.

Lebia viridipennis, *Dej*.

This is mentioned as a rare species in Indiana by Blatchley who found once an adult as late as Dec. 28.

One mature specimen was uncovered here underground October 21.

Notiophilus aeneus, *Hbst*.

One beetle of this species was taken under loose leaves in a thinly wooded lot bordering a stream, February 2.

Amara musculus, *Say*.

This species is mentioned by Forbes in the 23rd Report of the State Entomologist of Illinois (page 177) as feeding upon the husks and ears of standing corn.

Only one specimen was taken by my and that October 30. The species probably hibernates as a beetle.

Amara cupreolata, *Putz*.

Beetles of this species were taken January 27, under loose leaves along a rail fence, andMarch 16 from under leaves in a cemetery.

Amara pallipes, *Kirby*.

The adult stage of this insect was found under loose leaves and trash at the border of a dense woods, Mar. 18.

Bembidium 4-maculatum, *Linn*.

Beetles of this species were found in Indiana, during the winter by Blatchley. An adult was taken here under leaves and

trash at the border of a dense wood, March 18.

Tachys incurvus, Say.

This species is listed by Blatchley as hibernating in the beetle stage under chunks and stones in damp localities.

A beetle was taken here under loose earth October 26.

Olisthopus micans, Lec.

One beetle was removed from under loose earth, October 26.

Platynus placidus, Say.

One adult was found under trash beside a road, March 2.

Calathus gregarius, Say.

Blatchley finds this beetle very common during winter in Vigo County, Indiana, under logs in dry upland woods.

A beetle was taken by me among loose leaves in an abandoned orchard, November 3.

Leptotrachelus dorsalis, Fab.

One adult of this species was found under leaves in a cemetery, March 16.

Staphylinidae.

Paederus littor~~ari~~eus, Grav.

The adults of this species were found during the winter in Indiana by Blatchley between the leaves of almost every mullein plant.

This was the commonest of the Rove beetles seen by me in hibernation. Specimens could be found at all times, under trash and chunks of wood, actively moving about often several inches below the surface. They were recorded for October 13 under matted grass, October 15 under a log, October 26 underground, November 13 in underbrush, November 26 and December 4 under trash and March 3 under an Osage orange hedge.

Sunius longiusculus, Mann.

The beetles of this species were also found commonly by Blatchley in Indiana during winter.

During the present season, adults were taken November 13 in underbrush, November 27 under an osage orange hedge, and March 18 under leaves and trash along the edge of a dense wood.

Stilicus dentatus, Say.

An adult of this species was found November 27, under leaves by an osage orange hedge.

Actobius jucundus, Horn.

This species was taken as an adult, October 21, underground.

Xantholinus sp.

Adults of this genus were taken in leaves and rubbish, October 21, and in a similar location, March 24.

Tachyporus elegans, Horn.

Mature insects of this species were taken November 6 and March 4, under trash beside a fence.

Olophrum obtectum, Er.

One beetle was taken October 16 under matted grass.

Staphylinidae sp.

Several species of Staphilinidae which have not been identified were found in hibernation. The hibernation habits of all observed were very similar and simple, their ordinary activities being but little interrupted.

Phalacridae.

Eustilbus apicalis, Mels.

Forbes, in the 23rd Report of the State Entomologist of Illinois (page 180) reports adults of this species in injured

grains of corn at the tips of ears and as very abundant in shocked wheat. They are found under bark and sticks in early spring and are believed to subsist mostly upon pollen and fungus spores.

Beetles of this species were taken, slightly underground, October 21, and on the ground in blue grass, November 26.

Eustilbus nitidus, Mels.

This species occurred in the adult stage under loose earth, October 15, and under matted grass and leaves, October 19 and March 24.

Phalacrus politus, Mels.

Lintner in the 6th Report of the State Entomologist of New York (page 170) mentions this as a scavenger frequently noticed on wheat. It was found by Forbes on corn (23rd Report of the State Entomologist of Illinois).

A beetle of this species was taken by me March 5 under leaves beside a rail fence.

Corylophidae.

Orthoperus sp.

One species of Orthoperus in the adult stage was found by me on the bark of an apple tree in an orchard, March 15.

Coccinellidae.

Megilla maculata, De G.

This was by far the commonest Coccinellid found during the winter. It is generally known as an enemy of plant lice and also eats the eggs of insects. Forbes (12th report of the State Entomologist of Illinois) found that the food of specimens examined by him was about 54% of vegetable origin and 46% animal. He also reports the beetles as occurring in great swarms at the

edges of cornfields and under boards and rubbish, and a similar observation was made by Blatchley in Indiana. This is an excellent example of gregarious hibernation.

While found under almost any shelter such as trash and matted grass along fences and roadsides, the beetles were most abundant under leaves in an osage orange hedge, between two cornfields and close to a clover field. They were bunched together by the hundreds along the hedge and were to be seen there throughout the winter. By the middle of October they were in hibernation quarters and November 6 these swarms were first noticed, under leaves, and they were still active November 27 at the same place. January 21, during a thaw, the beetles were crawling about on the under sides of the leaves and above the melting ice. One hundred active specimens were taken from under the leaves at this time, and exposed in a wire cage a few inches above the leaves. When examined March 4 all in the cage were dead while apparently few of those under the leaves failed to survive the winter. At this time the beetles were moving about and coming out of their hibernation quarters.

Hippodamia 13-punctata, Linn.

This species is similar to Megilla maculata in respect to food habits and is reported by Blatchley to winter as an adult. It was not found in large numbers like that species however. Beetles were taken in sweepings as late as October 21. November 3 they were found under leaves along a fence, and November 6, under an osage orange hedge. Others were noticed under leaves March 1 and 3, and were apparently still in hibernation quarters March 24.

[illegible] under [illegible]
everywhere under [illegible].
the early [illegible] of [illegible] formation.

While these beetles were most [illegible] found [illegible] killed [illegible], the beetles were abundant under leaves in [illegible] other crevices [illegible] fields and also the clover field. [illegible] of the water. [illegible] in quarters, [illegible] leaves and [illegible] were [illegible] on the under side of the leaves [illegible]. One hundred active specimens [illegible] the leaves. [illegible] that while apparently few [illegible] under the leaves [illegible] survive the winter. [illegible] the beetles [illegible] coming out of their hibernating quarters.

Spotted Diabrotica, 12-punctata, [illegible].

[illegible]

Hippodamia parenthesis, Say.

This is also an aphid-eating insect found hibernating as an adult by Blatchley in Indiana.

A beetle was seen by me, Jan. 21, active under matted grass beside a wire fence. Others were found under trash along a roadside March 2 and under leaves in a cemetery, March 24.

Scymnus americanus, Muls.

This species apparently hibernates as an adult, since one beetle was taken under accumulations of rubbish, November 13.

Coccinella 9-notata, Hbst.

This beetle is reported by Forbes (23rd Report of the State Entomologist of Illinois, p. 231) as eating the leaves of corn. About 2/3 of the food, of specimens examined by him, was derived from such plants. The species was found by Blatchley during winter under mullein leaves and chunks of wood.

They were not found very common by me in hibernation. One adult was taken, March 4, under matted grass beside a wire fence. Another still in hibernation was found under leaves in an orchard March 15 and still another was taken on the wing, March 18.

Chilocorus bivulnerus, Muls.

This species is commonly reported as an enemy of scale insects. It is mentioned by Forbes (24th Report of the State Entomologist of Illinois, page 115) as destroying many Cottony Maple scales.

It was not seen by me in actual hibernation but was taken March 8 on the bark of a peach tree. A pair were noticed mating in an apple orchard March 17. According to Blatchley

this beetle hibernates singly, under chunks, in upland sandy woods.

Cycloneda sanguinea, Linn.

The food of this species is said by Forbes (12th Report of the State Entomologist of Illinois) to be about 1/3 plant lice.

Only a few adults were found here in hibernation. They were taken among trash November 3 and also from sweepings of grass and weeds, November 6. They were later found, Feb. 2, under leaves in a woodlot bordering a stream and again March 17 under leaves.

Anatis 15-punctata, Oliv.

This species is reported to feed on plant lice by Lintner, in his 8th Report as State Entomologist of New York, and on bark lice in an article in Insect Life, vol.7 page 239.

No beetles were found by me in hibernation but an adult was taken on the wing, April 4, and another the next day. April 7, a female was seen depositing eggs on the bark of an apple tree. Apparently the winter is passed as an adult.

Erotylidae.

Languria mozardi, Lat.

A full discussion of this insect is given by Folsom in his report on the Insects affecting Clover in the 25th Report of the State Entomologist of Illinois. It is not considered a pest although it attacks clover and would probably become injurious if present in great numbers. It is single brooded in this latitude and hibernates as an adult, but may hibernate as a larva also, since Chittenden found larvae in ragweed from November to April. They live on the pith in the stems and the beetles of

the next generation emerge from the first of August to the middle of September.

Beetles were found here underground October 26 and under rubbish and fallen weeds November 13.

Languria angustata trifasciata, Say.

This species was taken in the beetle stage November 13, under trash.

Cucujidae.

Telephanus velox, Hald.

Blatchley found this insect to be rare in Indiana during winter. It was seen by him beneath bark and once February 27, in cup fungus (Peziza coccinea, Jacq.).

Adults were found here very common during hibernation. They were first taken among leaves beside a fence, November 3. On November 6 they were swept from grass along a road. Large numbers were seen under leaves beneath a rail fence January 28 and March 16 in a cemetery. March 18 they were very active among the trash at the border of a wood. They were still under leaves in a cemetery April 1.

Histeridae.

Hister americanus, Payk.

Blatchley in Indiana once took this species January 6.

Adults were found here under leaves in a cemetery,March 16.

Hister harrisii, Kirby.

This species was taken with the preceding histerid and evidently is similar in hibernation habits.

Nitidulidae.

Epurea helvola, Er.

Two adults of this species were taken during the winter, one January 28, under loose leaves and trash beneath a rail fence bordering a woodlot, and a second beside the same fence, March 5.

Trogositidae.

Tenebrioides corticalis, Hbst.

The native species of this genus are referred to in the 23rd Report of the State Entomologist of Illinois(p.182) as living under bark.

Beetles of this species were taken on November 3 under leaves in a small abandoned peach and cherry orchard and again on March 16 under leaves and trash in a cemetery.

Lathridiidae.

Corticaria distinguenda.

The insects of this family are mentioned by Comstock as living under bark and stones.

The species was taken as an adult on March 18 under leaves and trash along the border of a dense wood.

Heteroceridae.

Heterocerus sp.

Two specimens of these sand burrowing beetles were taken in the fall. One was underground October 26 and the other in rubbish at the same place, October 30, the location being the sandy bank of a drainage ditch.

Elateridae.

The wireworms are known to spend more than one year and some of them as many as three years in completing a life cycle. The

life history has been studied by Comstock and Slingerland in New York and by Forbes in Illinois. The beetles which appear in the spring emerge from the pupal cells underground, in which they transformed the preceding autumn.

From the fact that several years are spent in the life cycle it is evident that in the winter at least two stages may be found, the growing larva as well as the transformed adult. Several larvae were noticed by me while digging in a cornfield, March 3, but the species was not determined.

Melanotus communis, Gyll.

The life history for this species in the 18th Report of the State Entomologist of Illinois (p.39) is given as not less than three years. Pupation occurs in July and the beetles transform in August, but remain in the pupal cell until the following spring. Harris reports finding adults under the bark of trees during winter and they are also mentioned by Blatchley as one of the commonest winter beetles under loose bark, mullein leaves &c.

Mature specimens were taken November 3 among leaves in an abandoned orchard, March 2 under the bark of a fallen log and March 18 in trash along the border of a dense wood.

Melanotus cribulosus, Lec.

This is reported by Forbes (18th Report of the State Entomologist of Illinois page 43) as one of the commonest wireworms in the cornfields of Illinois. The hibernation of adults, except in pupal cells, has never been ascertained by him.

Beetles were unearthed December 3 while digging in a cornfield, and both adults and undetermined wireworms were exposed in the same field March 3. The mature insects were apparently in

the pupal cells about eight or ten inches below the surface.

Drasterius elegans, Fab.

This click beetle is well known because of its injury to the roots of corn. The life history and hibernation of the insect has been studied by Forbes (18th Report of the State Entomologist of Illinois). The adult emerges in summer and early fall and some eggs are laid before winter as shown by young larvae. The life cycle is completed in two years. The following is a list of hibernation dates determined by him:- December 3,1884,December 2,9,16 in 1889, under boards on grass lands and December 4 under leaves of dock and other plants in cornfields,- December 23,1891 and Fefruary 25 under leaves in woods,- April 8,1890, from roots of old corn and from under boards,- March 31 and April 24,1884, still in hibernation in strawberry fields,- April 27,1892, specimens were taken on the wing at dusk.

Several adults of this species could usually be found together under boards or trash during the period of hibernation. After the cold weather of early December they became inactive and remained in this dormant condition throughout the winter, though activity was quickly assumed on their being brought into the laboratory. October 19 and 26 they were found under loose earth among weeds beside a fence, and again, November 13, under trash. A few were uncovered February 2, from accumulations of leaves in a woodlot. Numbers were found March 2 under loose boards along a road bordered by cornfields and again March 18 under leaves at the edge of a dense wood. March 24 several beetles attempted to escape from my hand by clicking, but apparently were not leaving hibernation shelter when undisturbed.

Monocrepidius auritus, Hbst.

Blatchley found these beetles very common in Indiana in winter beneath logs and mullein leaves on sandy hillsides.

During the present winter a mature insect was exposed April 1 from under a stone slab in a cemetery.

Cryptohypnus obliquatalus, Mels.

This species was frequently seen during the winter, by Blatchley in Indiana, beneath logs on sandy hillsides.

Adults were taken by me on November 3 beneath loose earth beside a weedy fence row.

Lampyridae.

Chauliognathus pennsylvanicus, DeG.

This beetle was found hibernating in the larval state. Adults were very abundant on golden rod in the fall, occurring as late as October 9. During the latter part of the winter and the early spring the velvety grubs, then about one inch in length, were found under loose boards, chunks of rotting wood and other trash. They were quite common along a roadside, March 2, and under trash beside an osage orange hedge March 17.

Cleridae.

Cymatodera balteata, Lec.

This insect is reported by Forbes as predaceous on Oberea ulmicola. The active larva burrows into an infested twig and destroys the Oberea larva. The adults may be captured from late July to September (24th Report of the State Entomologist of Illinois, page 130).

An adult beetle was taken by me from under leaves in an osage orange hedge, November 6.

Scarabaeidae.

Ataenius cognatus, Lec.

Blatchley reports that the adults of this species hibernate beneath cow dung and the earth under it.

Adults were fairly common at Urbana under the accumulations along fences, and usually about an inch below the surface in loose earth. They were found October 13 under leaves and trash and underground, October 15 and 21. They were still in hibernation quarters March 23, but on April 1, large numbers were caught on the wing.

Aphodius inquinatus, Hbst.

According to Lintner (3rd Report of the State Entomologist of New York, page 102) this insect was introduced from Europe. Lintner says that there are two broods and that the winter is passed in both the larval and the pupal stages.

Beetles of this species were caught on the wing at Urbana in large numbers during the latter part of October and until November 27. They were common on the wing again as early as March 4.

Aphodius serval, Say.

This species was not taken commonly. It was found under trash March 1 and again under leaves in a cemetery, March 16.

Onthophagus hecate, Panz.

A mature insect of this species was taken from under leaves and trash in a cemetery, March 16.

Bolboceras farctus, Fab.

One adult was swept, October 4, from grass, weeds and clover.

Chrysomelidae.

Diabrotica longicornis, Say.

The life history of this corn root pest has been studied by Forbes (18th Report of the State Entomologist of Illinois). It is considered by him to be the most destructive corn insect depending upon that plant alone. It was found to hibernate as an egg, laid late in the fall, in the earth in cornfields. The eggs hatch in spring and the young larvae feed on the corn roots. It is single brooded. The latest date given for adults in the fall is December 16, 1892, though very rarely a specimen or two has been found by him in spring.

The beetles of this species were very abundant in the fall, principally in sweepings from grass and weeds. None were taken later than October 21.

Diabrotica vittata, Fab.

The life history of this common cucurbit pest is discussed by Chittenden in Circular 31, U.S. Dept. of Agr, Bureau of Entomology. It is said to hibernate as a beetle, hibernation beginning at Washington, D.C., with the first cold nights of October and the beetles appearing again in April and May. It was also found during winter as a beetle by Blatchley in Indiana under logs and rubbish especially in sandy places.

Adults were easily found during the present winter. October 30 a few had taken shelter under trash along a fence, but on November 6 one was taken on the wing. They were found under leaves and trash Nov. 27, March 5 and March 24.

Diabrotica 12-punctata, Oliv.

The larvae of this beetle are known to live upon the roots of sedges and corn. There is some uncertainty as to the exact life

history. The species was said by Riley (Insect Life, Vol. 4, page 104) to winter as an adult and to have two generations. Forbes (18th Report of the State Entomologist of Illinois, page 149) says that it is probably two brooded, and that it may hibernate as an adult.

The beetles of this species were common in sweepings from grass as late as October 28. November 13 they were found in rubbish along a fence, November 26 they were taken both on the ground and on grass, and December 4 on the ground. None were seen thereafter until April 10, when a beetle was captured on the wing. It would seem that the beetles winter over, although the method was not observed. Apparently they go underground.

Disonycha xanthomelaena, Dalm.

The Spinach flea beetle has been studied by Chittenden (Bulletin 43 n. s. Bureau of Entomology). It feeds naturally upon weeds and wild plants, but severely attacks beets and spinach. The beetles appear early in spring. The first generation develops on chickweed, and the second attacks spinach.

Only one adult was taken here, and that from under trash, November 13.

Disonycha collata, Fab.

The beetles of this species have been found frequently by Blatchley during the winter in Indiana, beneath mullein leaves and rubbish.

One adult was taken December 4 at the roots of blue grass beside a railroad.

Oedionychis gibbitarsa , Say.

This species is known to hibernate as a beetle, having been

collected by Blatchley in In iana during the winter.

It was taken quite frequently by me during the present season in sweepings from weeds October 13, from trash under an osage orange hedge January 21, under the accumulated rubbish along a rail fence, January 28 and March 5. February 2 I found it under leaves in a woodlot.

Oedionychis thyamoides Cr.

Adults of this species were taken October 15 underground and among leaves and rubbish, October 21.

Myochrous denticollis, Say.

This species is referred to as the southern corn leaf beetle by Webster in Bulletin 46, Bureau of Entomology. It is believed by him to hibernate, in part at least, in the adult stage. The adult was once taken by Blatchley in Indiana, February 28 under a chunk of wood on a river terrace. It is also recorded in Illinois, (23rd Report of the State Entomologist of Illinois, page 104) as takon December 8.

A few beetles of this species were collected during the present season,- among fallen leaves, October 26; underground, November 3; and in underbrush, November 13.

Calligrapha similis, Rog.

This species is reported by Bätchley to hibernate as a beetle in Indiana.

Adult s were taken here October 26 underground, and December 4 under tufts of grass and blocks of wood and other trash.

Labidomera clivicollis, Kirby.

This is mentioned as uncommon by Blatchley in Indiana. A bettle was once taken by him January 5 from beneath mullein leaves.

One specimen was taken here - a beetle, on Indian hemp, Oct. 9.

Lema trilineata, Oliv.

This is known as the three lined potato beetle. It was found by Riley to winter as a beetle (1st Report of the State Entomologist of Missouri, page 99). The larvae of the second brood go into the ground to pupate. The beetles transform in the fall but do not emerge until the next spring.

Only one beetle was seen during the present season, and that underground October 15.

Crepidodera longula, Horn.

Adults of this species were taken October 21, in rubbish, slightly below the surface in loose earth, and also underground in the same location, November 3.

Crepidodera helxines, Linn.

Adults were taken on grass and weeds October 4, underground October 21, and in rubbish beside a fence October 30.

Chaetocnema denticulata, Ill.

This species is known as the toothed flea beetle. It is referred to by Forbes as a grass and grain beetle which also attacks corn. It has been found in winter quarters and is double brooded (23rd Report of the State Entomologist of Illinois, page 110). It has also been reported as frequent during winter in Indiana by Blatchley.

It was taken as an adult here under rubbish by a fence, October 30.

Chaetocnema confinis, Cr.

This species is mentioned by Forbes (23rd Report of the State Entomolist of Illinois, p. 110) as doing much injury to young corn. It is given as hibernating in the beetle stage.

Beetles were very common in grass and trash along fences during the fall as late as November 13.

Chaetocnema pulicaria, Meld.

This is referred to as the Corn flea beetle by Forbes in the 23rd Report of the State Entomologist of Illinois (page 109). The winter is passed as an adult.

The latest record for this species during the present fall was October 30. It was found in similar locations with the preceding species and the two were not distinguished in the field.

Haltica chalybea, Ill.

The grapevine flea beetle is discussed by Marlatt in Farmers' Bull. 70, U.S.D.A. The beetles appear early in spring and bore into and scoop out unopened buds, often killing the plant back to the roots. The eggs are deposited on the expanding leaves, and the larvae are to be found there during May and June. They go into the ground to pupate, the beetles emerging in the latter part of June and July. After emerging, the beetles remain on the leaves throughout the summer and fall but do little damage. In the fall they go into winter quarters in any protection, such as cracks in fences or buildings, in masses of leaves and in underbrush.

A beetle of this species flew against the window of the laboratory, March 25.

Haltica bimarginata, Say.

This is referred to as the Alder Flea Beetle by Lintner in the 4th Report of the State Entomolist of New York (page 96).

A mature specimen of this species was taken on the wing

April 1.

Glyptina brunnea, Horn.

This beetle is mentioned by Forbes in the 23rd Report of the State Entomologist of Illinois (page 191) as attacking corn. Its life history is unknown.

Adults were taken at Urbana early in fall, being plentiful in sweepings from blue grass and foxtail October 7. None were seen during the winter.

Typophorus canellus, Fabr.

One beetle of this species was found under leaves and trash along the edge of a dense wood, March 18.

Tenebrionidae.

Alobates pennsylvanicus, Deg.

This beetle is frequently found under the loose bark of dead and fallen trees during the spring and summer. It is reported by Blatchley to hibernate, in Indiana, in its usual abiding places.

Only one was found hibernating here, and that not until March 16, under leaves and trash in a cemetery.

Arrhenoplita bicornis, Oliv.

Beetles of this species were taken from a fungus growth under the bark of a stump October 30.

Anthicidae.

Anthicus servinus, Laf.

Adults of this species were swept from grass along a roadside, November 6. They were again taken, March 4, under an osage orange hedge.

Anthicus sp.

A species of this genus was swept from grass along a roadside, November 6. The same or a very similar species was taken from rubbish and fallen leaves November 13 and 20.

Anthicus formicarius, Laf.

Beetles were taken near the surface under loose earth among weeds, October 26. November 13 they were found at the same place in trash along a fence.

Notoxus monodon, Fab.

This beetle is reported by Blatchley as wintering as an adult in Indiana beneath chunks on sandy hillsides.

Adults were exceedingly common with us in hibernation. They were usually found under leaves and those under an osage orange hedge seemed to be a favorable shelter for them. My first specimens were taken from such a situation November 6, and again November 27. Others were under leaves and trash along a rail fence January 27 and 28. March 18, large numbers were actively crawling about among the leaves at the edge of a dense wood, and others, March 23 under the leaves in a cemetery. One specimen was caught on the wing April 9.

Otiorhynchidae.

Tanymecus confertus, Gyll.

The hibernation of this species is discussed in the 18th Report of the State Entomologist of Illinois (page 143). It is apparently single brooded and hibernates as a beetle.

An adult was taken underground October 26.

Phyxelis rigidus, Say.

One adult was taken under the loose trash under a rail

fence, March 5.

Curculionidae.

Apion sp.

Adults of this genus were taken in sweepings from grass, November 6, and under leaves and trash November 13 and again March 18.

Phytonomus punctatus, Fab.

The life history of this species is given by Folsom in the 25th Report of the State Entomologist of Illinois. The winter is passed as a small larva under the rubbish of a clover field. Adults may be found during the winter, but do not reproduce or feed upon clover in the spring.

A beetle was seen crawling on a cement walk, November 20.

Smicronyx ovipennis, Lec.

An adult, March 2, under loose boards beside a road.

Lixus concavus, Say.

This beetle is known to hibernate as an imago. Chittenden (Bulletin 22 n. s. Bureau of Entomology) refers to it as an enemy of rhubarb. He says that it hibernates as a beetle, and that it may issue from the pupal burrows in fall before entering into hibernation. It has been found during winter by Blatchley in Indiana beneath bark and logs in dry upland woods.

It was taken here in rubbish along a fence October 30.

Rhyssematus palmicollis, Say.

This species has been recorded by Webster as grown from a fungus gall on Gopher vine (Ipomea pandurata).

A beetle was taken underground near a clump of milkweeds, October 26.

Rhyssematus lineaticollis, Say.

This species breeds in the seed pods of Asclepius incarnata, the larvae feeding on the seeds and transforming to the adult in late autumn - F. L. Webster, Insect Life, Vol. 2.

Examples were taken from the pods of milkweed, November 13. Larvae and pupae probably of the same species were in the pods at the same time.

Baris aerea, Boh.

An adult was taken underground, October 21.

Baris confinis, Lec.

The larvae and pupae of this species are mentioned as common in the stems of Spanish needle, by Weed - Insect Life, Vol. III, 261.

The imago of this species was taken during October and November 13 in rubbish and weeds.

Calandridae.

Sphenophorus callosus.

One adult was taken underground, October 21, in loose sandy loam.

HEMIPTERA.

Emesidae.

One species of this family was taken,October 26, as an adult in the trash along a fence.

Reduviidae.

Melanolestes picipes, H. Schf.

Howard refers to this in Bulletin 22 n. s. Bureau of Entomology as a swift running species found under stones and logs.

It hibernates, he says, in valleys beneath stones and logs, but Blatchley found it rather common in dry upland woods, beneath logs.

During the fall nymphs of different sizes were taken here among leaves and trash along fences. November 13 a partly grown nymph was taken in such a location.

Nabidae.

Nabis ferus, Linn.

This species is known to feed upon small insects. It is reported by Blatchley as a common winter resident in Indiana, hibernating as an adult beneath logs and leaves of mullein along roadsides and the borders of dry upland fields.

Adults were very abundant in hibernation at Urbana. They apparently had no preference as to hibernation quarters but could be found wherever there was enough trash to afford protection. They were actually taken under leaves, under trash along fences and hedges, on the ground under matted grass, and a few were found below the surface especially where the soil was quite loose. They were collected from rubbish late in October and all through November, although one was caught on the wing as late as November 6. They were active with the first warm weather of spring and on warm days in winter but were not then found away from the protection of trash or grass.

Nabis punctipes, Reut.

This species is reported by Blatchley to be rare in Indiana in winter.

Nabis punctipes was similar in habits and in places of hibernation to the preceding species, Nabis ferus, but was not

so abundant.

Nabis rufusculus

Only two adults of this species were seen. They were taken among leaves and trash beside a fence, November 3 and 6.

Nabis sp.

An unidentified nabid was taken December 4, from under tufts of unburnt grass in an area burned over the preceding week.

Tingitidae.

Piesma cinerea, Say.

This is referred to as the Pigweed bug in the 21st Report of the State Entomologist of Illinois(page 85). It also attacks beets. The adults are mentioned as very abundant in May and early July and again from October onwards, passing the winter under any convenient shelter but especially under the loose bark of trees. Blatchley says the species winters under logs and beneath the bark of red and black oaks, especially near the base of the tree.

Adults were very common in hibernation at Urbana, and were found under leaves and trash beside a fence, October 15, under an osage orange hedge, November 27, and under the rotted leaves and trash in a woodlot, March 18. They were also taken from fissures of the bark of apple trees, November 17, and from the same kind of places, March 15. They were still under rubbish and trash, March 24.

Acanthidae.

Triphleps insidiosus, Say.

Forbes (23rd Report of the State Entomologist of Illinois, page 202) refers to this as a partly predaceous species which is

undoubtably injurious at times to corn. Its hibernation habits are mentioned as uncertain, no specimens having been taken earlier than April 30 nor later than October 26.

The adult of this species was quite common at Urbana in early fall in sweepings and later it was found in loose trash,-the last time October 21. Adults were swept from grass and weeds and were also taken in leaves and rubbish beside a fence, but none were seen during the winter.

Capsidae.

Lygus pratensis, L.

This was one of the commonest insects in hibernation. It is reported by Lintner(13th Report of the State Entomologist of New York, page 356) that the hibernating adults leave their shelter early in spring, and feed on unfolding buds. They deposit eggs on or in the food plants and the first adults of the new generation appear in May and June. The hibernating adults are from the second generation in New York. Forbes mentions it in the 23rd Report of the State Entomologist of Illinois(page 118) as a very common insect on a great variety of plants. He reports it as hibernating in the adult stage under sticks and leaves and in tufts of plants and among other rubbish on the ground.

It was abundant in almost every place examined during the fall and winter. It was common until October 12 in sweepings from grass and weeds. After the cold snap at this time it was found on the ground among leaves and under matted grass. Its hibernation was incomplete, some being taken in sweepings from grass as late as November 20. During the winter it was found under loose boards, leaves, along osage orange hedges and in

matted grass; and it became active on warm days throughout the winter. January 28 it was seen in considerable numbers moving actively about among loose leaves beside a rail fence. By March 18 some had left their hibernating quarters and were flying about.

Calocorus rapidus, Say.

I could find no statements concerning the hibernation of this leaf bug. It was common in sweepings from grass, weeds and clover in the early part of October and was taken as late as October 26 but not after that date.

Lygaeidae.

Ischnodemus falicus, Say.

Adults and nymphs of this species weretaken during the fall from the under sides of the leaves and from between the sheaths and stems of slough grass(Spartina michauxiana, Hitche). The great majority of the slough grass stems examined contained these bugs. They were first taken October 4 and seen every few days until November 13, when they were found in rubbish and trash and were no longer on the slough grass. No specimens were taken after November 13. The latest record for a nymph was October 16.

Ligyrocoris constrictus, Say.

Blatchley refers to this species as rare in Indiana during winter. It was once taken by him December 10, under logs.

One adult was taken here in sweepings, October 9.

Oedancala dorsalis, Say.

One adult of this species was found among leaves and trash in an old orchard, November 3

Geocoris uliginosus, Say.

The adults of this species were quite common and active in

trash along a wire fence during October and they were taken also in sweepings as late as November 6. A number were found under trash along a fence on the same day. January 27 and 28 two adults, one living and one dead, were found under the trash beside a rail fence.

Microtoma carbonaria, Rossi.

Blatchley mentions the adults of this species as hibernating singly or in pairs beneath logs, chunks of wood, and leaves of mullein.

March 18 a large number of adults of this species were found by me among fallen leaves at the edge of a dense wood. They were decidedly active and would quickly attempt to escape when the leaves and trash containing them were spread out.

Blissus leucopterus, Say.

The hibernation of this common and destructive pest has been extensively discussed by Webster in Bulletin 69 of the Bureau of Entomology. So far as known only adults winter over. With the increase of cultivated areas the bugs have come to hibernate largely in the limited areas of woods under leaves and trash and along fences under matted grass, and along osage orange hedges. Webster mentions corn shocks as a particularly favorable winter shelter.

The chinch bug was rare in this locality during the present winter. One adult was found under leaves and trash by a wire fence November 6 and another was taken from under leaves by an osage orange hedge, March 17. The next day a third adult was found in trash at the edge of a thickly wooded lot which was bordered by a pasture and a cornfield.

Lygaeus kalmii, Stal.

This species was very common during the fall. A few immature bugs were found in trash as late as October 28. Adults were common enough to be found at any time during the fall in trash along fences and in grass and weeds. They were active in the fall as late as November 20. The were found under a rail fence January 28. January 29, sixteen adults were found in a bunch moving sluggishly about under a mass of matted grass beside a railroad embankment. Two dead adults were seen under the same protection, but so far as noticed few failed to winter over. Adults were still under leaves and trash in a cemetery, March 16.

Myodocha serripes, Oliv.

Kellogg mentions this species as common in meadows and thin woods half concealed among twigs and fallen leaves.

During the fall adults and nymphs were found under leaves and trash, in grass and weeds, and under fallen leaves beneath an osage orange hedge. A nymph was seen as late as November 20. Several adults were found under a rail fence, March 5; and March 24 about 20 were taken within the space of a square yard under leaves and matted grass in a cemetery.

Pamera basalis, Dallas.

Blatchley found this species rather common throughout the winter in Indiana, beneath logs, stones, and rubbish along the borders of cultivated fields.

Adult bugs were collected by me in fall until November 26 and again in spring on March 18. They were among leaves and grass along weedy fence rows and under accumulations of leaves in a cemetery. They were still under shelter, March 24.

Berytidae.

Jalysus spinosus, Say.

Blatchley found this species during the winter in Indiana beneath logs and mullein leaves.

It was taken here October 4 in grass and weeds and October 21 in leaves and trash along a fence. The last specimen was immature.

Coreidae.

Alydus pilosulus, H. Schf.

This species was rather common in fall in sweepings from blue grass and foxtail. It was found under matted grass October 19 and taken in sweepings November 6. October 26 a number were seen crawling on the gravel of a railroad.

Alydus conspersus.

The imago of this species was taken from grass, clover, and weeds, October 4.

Alydus eurimus, Say.

This insect was found as an adult, November 6, in trash and leaves beside a fence.

Catorhintha mendica, Stal.

Immense numbers of this species were seen swarming over Cockle bur (Xanthium sp.) growing in a drainage ditch beside a railroad. A few were immature. They were feeding on the sap exuding from wounds in the plants, although they were not observed to make any punctures. October 16, none could be found on the cockle burs but they were found among the leaves and trash beside a nearby fence. October 26 a few were seen crawling along the gravel in a railway roadbed. They were last

seen in that locality, November 3, when a few were found in trash along a fence.

Leptoglossus oppositus, *Say*.

This species is mentioned by Chittenden as feeding on cucurbits (Bulletin 33 n. s. Bureau of Entomology). It is said to have but one generation, the first adults appearing about September 10 in Washington, D.C. It was rare there after the severe winter of 1899. It has also been found attacking corn in Central Illinois (23rd Report of the State Entomologist of Illinois, page 197) and is mentioned as locally though not generally distributed there.

One adult was found under leaves and trash beside a fence, November 6.

Anasa tristis, *De G.*

Chittenden (Circ. 39, U.S.D.A., Div. of Ent.) found this species to begin hibernation in September, hiding under boards, stones, old vines or similar vegetation or under the loose bark of dead trees or in cracks of barns. It was found by Blatchley in Indiana in numbers beneath the loose bark of stumps often far removed from its food plant.

October 2 three adults were taken by me on the rails of a railroad, apparently in search of hibernation shelter. One was taken October 7 in sweepings.

Corisus lateralis, *Say*.

This species hibernates as an adult. In the 21st Report of the State Entomologist of Illinois (page 56) Uhler is quoted as finding two generations, the second of which winters over.

Adults were exceedingly common at Urbana during the fall,

and were to be found during the winter in any convenient shelter. They were taken in sweepings as late as November 6. On cold days during October, they were seen under matted grass and trash, being first found in such places during the cold snap October 13. October 16, as the weather became warmer, large numbers were seen crawling out of shelter and up on the standing grass and weeds nearby. They became torpid with cold weather and remained dormant or sluggish throughout the winter, under matted grass, leaves, trash, boards, and along osage orange hedges. Fewer were to be seen the latter part of the winter and some were found dead. January 27, out of five found together under a rail fence, one was dead and several were found dead the next day under a tuft of grass. Out of eight found under leaves in a park February 2, one was dead. March 18 they had become somewhat active and were crawling about among the leaves in a woodlot.

Pentatomidae.

Cosmopepla carnifex, Fab.

This species was taken on grass and weeds October 1 and 13. March 18 an adult was found under leaves in a woodlot but it was inactive and did not revive on being brought into the laboratory.

Coenus delius, Say.

Adults were taken in early October on grass and weeds, November 20 from under rubbish beside a fence, and December 4 from under loose boards.

Podisus maculiventris.

Adults were taken on cockle-bur October 9, in sweepings

October 30 and under leaves at the edge of a dense wood, March 2.

Euschistus variolarius, P.B.

This species is mentioned in the 23rd Report of the State Entomologist of Illinois (page 195) as sucking the sap from a great variety of plants, including corn. It is said to hibernate as an adult, having been taken from February 20 until December 20.

Adults were found by me in shelter as early as October 16 and a few were caught on the wing as late as November 27. Hibernation occurred in a great variety of shelters such as leaves and trash beside fences and osage orange hedges, but by far the most favorable shelter seemed to be the loose leaves and matted grass in woods, and especially near the edges of woods. Some were found under matted grass as late as April 1. March 24 three mature bugs were found dead under leaves in a cemetery but most of the adults seemed to have passed the winter alive.

Murgantia histrionica, Habn.

The Harlequin cabbage bug is a southern pest which has spread northward from Mexico. It was found by Riley (Report of U.S.D.A. 1884, page 309) to hibernate as a full grown bug under all sorts of rubbish, under stones, logs in fence corners, around out buildings, and in other like situations. Chittenden (Bulletin 22 n.s. U.S. Bureau of Entomology) found this species very rare in Washington, D.C., after the severe winter of 1899. A similar effect of severe winter weather was noticed by Webster in Ohio, the area of distribution of this species having once nearly reached Lake Erie, but having afterwards been forced

back to the Ohio River counties. The species is discussed by Sanderson (Journal of Ec. Ent., Vol. 1, Aug. 1908) in relation to the effects of minimum temperature in limiting the northern distribution of insects. He thinks that it may yet migrate as far as northern Ohio or Ontario.

One adult was found here by Hugh Glasgow, January 25, under trash near a cabbage patch.

Mormidea lugens, Fabr.

Blatchley found adults of this species rare in winter beneath chunks of wood and leaves of mullein.

Adults were found at Urbana on March 5.

Neottiglossa undulata, Kirby.

This species was taken in the adult stage, March 18, under leaves at the edge of a dense wood.

Nezara hilaris, Say.

This bug is said by Riley to be both carnivorous and herbivorous - (Insect Life, Vol. 4, page 158).

An adult was taken March 2 from under leaves and matted grass at the edge of a dense wood bordering a cornfield.

Peribalus limbolarius Stål.

This species was found quite commonly during the fall in the trash and leaves along fences. It passed the winter as a mature bug in such shelters, being found again March 3, under an osage orange hedge, March 2 under leaves near the edge of a woodlot bordering a pasture and cornfield and at the same place again on March 18. March 3 a specimen was found crawling on a board walk on the campus.

Corimelaenidae.

Corimelaena pulicaria, Germ.

This small negro bug has been occasionally mentioned as a pest. Davis (Bull. 102, Mich. Ag. Exp. Sta.) reports it as very destructive to celery in Michigan in 1893 and says that it hibernates under boards and trash. In the 21st Report of the State Entomologist of Illinois, page 99, it is referred to as infesting grain, grass, and weeds, and is said to be single brooded and to winter as an adult. Blatchley found it in Indiana beneath rails and dead leaves in fence corners - February 11-25.

Adults were taken by me during the present season January 28 and March 2, under leaves at the edge of a dense wood bordering a pasture and a cornfield and under sticks and leaves beneath a rail fence.

Corimelaena gillettei, Van D.

One adult was taken from the loose earth under weeds and trash beside a wire fence, October 21.

Corimelaena nitiduloides, P.B.

One adult, October 1.

Corimelaena unicolor, P.B.

This species hibernates as an adult. It was taken October 21 under loose earth and rubbish beside a fence and October 26 and 30 among leaves by the same fence. March 3 an adult was found under the leaves of a roadside osage orange hedge bordering a cornfield.

Fulgoridae.

Stobera tricarinata, Say.

In the 21st Report of the State Entomologist of Illinois

(page 67) this species is said to hibernate as an adult, one generation maturing in June and July and a second continuing from fall until April and May.

Adults were taken occasionally this year, from October 1 until November 26, on the damp ground, or on sedge between railway embankments. One adult was found in midwinter, February 2, under loose leaves and grass in a patch of woods on a hillside bordering a stream.

Stenocranus dorsalis.

Adults of this species were taken from October 1 until November 26, in similar localities and under the same conditions as the preceding species, but no trace was seen of it later in the winter. It was much more abundant than Stobera tricarinata.

Jassoidea.

Diedrocephala mollipes, Say.

This species is mentioned in the 21st Report of the State Entomologist of Illinois (page 71) as feeding principally on sedges, grasses and grains. It is credited with two broods and is reported to occur in the adult stage as late as December 18, the winter however being passed mostly in the egg, although a few nymphs probably hibernate. The eggs hatch in May.

This species was very abundant in October in sweepings from grasses and sedges, but began to fall off in numbers during November. It was found in leaves and trash November 13 and on the ground between sedges November 26. No adults were noticed later than this, but a nymph was taken under leaves and matted grass, March 18.

Gypona octolineata, Say.

In the 21st Report of the State Entomologist of Illinois (page 66) this species is mentioned as fairly common. It was taken from sugar beets, preferring the rank growth in shady places. It is there said to be double brooded and probably to hibernate as an adult.

Adults were quite common at Urbana during the early fall on grass. At one point between railway embankments a large number of Indian hemp plants (Apocynum cannabinum) were growing and G. octolineata was common on this until October 12. October 12 was freezing cold and a few sluggish adults were picked from plants. They were resting at the base of the leaf on the upper surface. A few more were seen the next day in the same place, but when next observed the leaves had fallen and none were to be found. The last specimens seen were caught on the wing, October 30. A dead adult, probably of this species, was found under leaves, March 24.

Acocephalus albifrons, L.

But two specimens of this species were taken during the present season,- an adult found under trash beside a fence, November 6, and another caught December 4, just as it flew to the ground.

Phlepsius irroratus, Say.

This species is very common. It is mentioned in the 21st Report of the State Entomologist of Illinois (page 76) as abundant on growing wheat and sometimes occurring on sugar beets. It is said to hibernate in the egg stage.

Adults were very common in sweepings from grass in the early

fall. October 15 they were found under leaves and trash, and on October 16 in matted grass. October 9 a cloud of insects, almost entirely Phlepsius irroratus, was noticed about sundown around a poplar tree on one of the city streets. Large numbers were on the leaves as well as in the air. No trace was seen of the species during the winter.

Agallia sanguinolenta, Prov.

Osborn and Ball in studies of North American Jassoidea mention the adults of this species as appearing in July and August and passing the winter in this stage, the species being single brooded. Forbes found this species to hibernate mostly as an adult under various rubbish, old boards, and hay (21st Report of the State Entomologist of Illinois, page 66). It is reported as feeding upon a large number of plants.

Adults were very common during last fall and winter, hopping actively about on warm days among the leaves and trash under osage orange hedges, and along roadsides and weedy fence rows. A nymph of this species was taken as late as November 6. They were active and abundant under an osage orange hedge December 3 and March 3. They were found, March 2, under roadside trash, but not so plentiful as under the hedges.

Agallia 4-punctata, Prov.

The life history of this species has been worked out by Osborn and Ball in Iowa - (Studies in North American Jassoidea). There is a single brood, the adults occurring from early May until into July. The eggs are deposited by the middle of June and the larvae issue in July and by fall are nearly or quite full grown, passing the winter and emerging as adults in early

spring. The larvae remain on or near the ground concealed in rubbish.

A nymph of this species is recorded for November 3. It was taken among loose leaves and trash beside a fence.

Deltocephalus inimicus, Say.

The life history of this species has been worked out in Iowa by Osborn. He is said in the 21st Report of the State Entomologist of Illinois (page 74) to have found the eggs beneath the epidermis of blue grass, in minute blister like swellings of the leaves near their tips which invariably turn yellow beyond the point of injury. There are two broods in a season and three molts before the adult. The winter is passed in the egg which hatches early in May.

No trace of this species was found during the winter, although it was abundant on grasses in October. The last record made for the species was on October 9, though it could probably have been found later in more suitable locations.

Deltocephalus nigrifrons, Forbes.

This is mentioned as a common insect by Forbes in the 21st Report of the State Entomologist ofIllinois (page 66), in which it is said to hibernate almost certainly in the egg.

Adults were found by me on grass and weeds in pastures and along roadsides during October and on November 6, 13, and 26, but none were found during the winter.

Deltocephalus affinis, G. and B.

Adults of this species were occasionly taken by sweeping grass during the fall but it was not found during the winter. The latest record for it this season is November 6.

Gnathodus punctatus, Thumb.

One specimen on the wing November 17.

Typhlocyba comes, Say - var.

In Farmer's Bulletin 70, Bureau of Entomology (page 18) Marlatt refers to the varieties of this species as swarming on grape leaves. The winter is passed in masses of leaves, especially where piled up against logs and fences. Marlatt has seen them by thousands on the warm days of early winter.

October 30 of last year they were flying in large numbers above fallen leaves near the border of a stream. January 28, a large number of adults were found along a rail fence beside a woodlot. When the leaves were turned over or disturbed they would fly or jump quickly about, presently alighting among the leaves again. They were present in immense numbers along the fence and under the leaves throughout the woodlot. In the same lot on March 5 large numbers were again observed to fly about when the leaves were disturbed. At no time during the winter were they noticed in a dormant condition.

Typhlocyba tricincta, Fitch.

This species was taken in the adult stage at the roots of blue grass, December 4.

Typhlocyba hartii.

Adults of this species were taken on the bark of Apple trees as late as October 21.

Typhlocyba vulnerata, Fitch.

This species is mentioned in the 21st Report of the State Entomologist of Illinois (page 79) as passing the winter as an adult under leaves and rubbish. It was found commonly on sugar

beet. The hibernating adults lay their eggs in April andMay.

An adult was taken by me October 30, near the bank of a stream.

Thamnotettix melanogaster, Prov.

Adults of this species were fairly common in sweepings from grass during the fall but none were found during the winter. The latest record was Nov. 6.

Thamnotettix ciliata, Osb.

This species was taken as an adult November 6, by sweeping grass. It was not found later than this.

ORTHOPTERA.

Acrididae.

Tettigidea parvipennis pennata, Morse.

This species is mentioned by Blatchley in his Orthoptera of Indiana as common in both dry upland woods and on low marshy tracts. It has been taken, mating, in all months of the year, and usually hibernates in colonies on the under sides of logs or chunks.

Adults were occasionally found hibernating during the present season, under leaves and trash along fences and under osage orange hedges October 26, Nov. 3, March 2 and March 16.

Tettigidea parvipennis, Harr.

This form of the preceding species is of similar habits. Adults were taken December 4 under a block of wood, and hopping actively about among dry leaves April 2.

Tettix ornatus, Say.

Blatchley in the Orthoptera of Indiana says that this

species may be taken at any time during the year, but especially in late autumn and early spring. It passes the winter as an adult.

It was taken here in the adult stage among leaves along a fence, October 26. A Tettix nymph was taken under ground, October 16, and another Tettix from underbrush by a fence, November 13.

Tettix ornatus triangularis, Scudd.

This form occurs more frequently than the preceding in sandy places according to Blatchley's Orthoptera of Indiana and in some places far outnumbers the typical variety.

Adults were found among leaves by a fence October 26 and November 3, and under a block of wood, December 4.

Chortaphaga viridifasciata, DeG.

This was found by Blatchley (Orthoptera of Indiana) to be the first locust to reach maturity in spring from hibernating nymphs, adults having been taken as early as April 15. It is double brooded, in some localities but singled brooded in Indiana. The young hatch in August and September and moult three or four times before winter.

Nymphs were taken occasionally during the present season,- October 26 in sweepings, October 30 along a roadside, November 20 on the ground in a burnt over area, and again under leaves in a cemetery on March 16. Adults were taken in an apple orchard April 8 and in a wood April 10.

Locustidae.

Ceuthophilus sp.

Nymphs of Ceuthophilus have been found by Blatchley in Indiana during winter beneath logs, and deeply buried in decay-

ing leaves and vegetable mold.

Nymphs were taken during the present season, October 21, underground, October 30 amongst rubbish andNovember 20 under rubbish near a fence.

Orchelimum or Xiphidium sp.

Imature insects of Orchelimum or Xiphidium were taken October 9 and 21 under leaves and rubbish.

Gryllidae.

Ellipes minuta, Scudd.

One specimen was taken underground in a sandy ditch, October 15.

Gryllus sp.

Blatchley found in Indiana that the eggs of G. pennsylvanicus and G. neglectus hatched in the fall and probably those of luctuosus also. Partly grown nymphs can be found in winter beneath logs, rails and other protective covers, often a dozen under the same cover, each in a cone shaped pit.

The young of Gryllus were frequently seen during the present season. They were taken in trash and grass October 15, underground November 3, and in a hibernating cell two inches below the surface in a cornfield, November 27. December 3 two were obtained from hibernating cells underground in a cornfield and March 2 large numbers were found along a roadside, under loose boards. They were in cells in the frozen earth and water but would move slightly when touched.

Nemobius fasciatus, DeG.

October 16, in weeds and trash.

Nemobius carolinus, Scudd.

This species was taken, October 30 under trash and November 3, underground.

Blattidae.

Ischnoptera sp.

As many as a hundred numphs of Ischnoptera have been captured by Blatchley in Indiana under loose bark. They were as active in winter at 0° as in summer.

Nymphs of this genus were found by me under leaves and loose trash beside a rail fence, January 28 and under leaves, February 2. March 2 large numbers were found under boards and corn stalks and under the bark of a stump. They were very active, and quickly escaped when disturbed.

DIPTERA.

Tabanidae.

Tabanus atratus, Fabr.

The life history of this fly is discussed by Osborn in Bulletin 5 n.s. Bureau of Entomology . The larvae are semi-aquatic and hibernate as such. One larva was under observation by him from September until July 13 when it pupated. Larvae are reported by Hart for every month of the year except June.

A larva of the Horse Fly was found underground by me October 12 and another in sandy soil near the banks of the Sangamon River, April 2.

Muscidae.

Pseudopyrellia cornicina, Fab.

Adult flies were found under fallen leaves, January 27, and March 2.

Oscinidae.

Elachiptera costata, Loew.

A fly of this species was found under fallen leaves in a thinly wooded lot, February 2.

Mycetophilidae.

Adults of this family were found among the rotting leaves and trash along a rail fence and in a woodlot January 28.

HYMENOPTERA.

Formicidae.

Camponotus fallax, Nyl.

subbarbatus, Emery.

paucipilus, Emery.

A colony of this species was found in a rotting block of wood in a thin woodlot, Feb. 2. Queens, males, and workers were found in the tunnels under the bark of the chunk. They were inactive but alive and revived on being brought into the laboratory.

Myrmicidae.

Cremastogaster lineolata, Say.

Winged females, males, and workers of this species were taken from gnawed out cavities in a small block of wood, November 20.

Vespidae.

Vespa maculata, Linn.

An adult wasp of this species was taken April 2, from a cell in a rotten log.

Vespa germanica, Fox.

Two adults of this species were found in a dormant condi-

tion under fallen leaves January 28 and March 1 respectively. Neither revived upon being brought into the laboratory.

Ichneumonidae.

Adult Ichneumons were found under leaves in a woodlot, January 28. The species was not determined.

Braconidae.

Adult Braconids of several species were found quite commonly during the winter under fallen leaves. They were seen November 27 on the wing, and January 27 and 28 and March 5 under leaves.

LEPIDOPTERA.

Noctuidae.

Leucania unipuncta, Haw.

The life history of the Army Worm is discussed by Forbes in the 23rd Report of the State Entomologist of Illinois(page 47). Certain parts of its life cycle are still imperfectly known. It is believed to hibernate in different stages. Young caterpillars have frequently been seen in fall, winter and early spring, and the full grown caterpillar has been recognized in the food of birds shot in February. The moths have been taken in March and the first half of April and J.B.Smith found them common in sheltered places throughout the winter. The pupa has also been asserted as a stage in which some of the insects may hibernate.

Very small larvae of the Army Worm were found by me on the ground among matted grass or slightly under loose earth, October 13.

Noctua bicarnea, Guen.

Small larvae of this cutworm were fairly common during the late fall. They were found in weeds and rubbish, October 19, slightly under loose earth, November 20, and on the ground, November 26.

Mamestra renigera, Steph.

This is mentioned in the 23rd Report of the State Entomologist of Illinois(page 35) as an abundant cutworm, principally a grass and garden species, but occasionally at the base of injured corn plants. There are two generations, one of which hibernates as a partly grown larva, having been taken from December to April.

A partly grown cutworm of this species was found under leaves and trash, March 24.

The Diamond Backed Cutworm.

One cutworm known commonly as the Diamond Backed Cutworm was taken under trash along a fence, November 26.

Arctiidae.

Diacrisia virginica, Fabr.

This species is mentioned by Forbes in the 23rd Report of the State Entomologist of Illinois(page 72). It is double brooded, the larvae of the first brood being common in June and July and the second in September. The larvae of the second brood pupate in fall and pass the winter in this stage. In common with the other species of Arctiidae it is a general feeder, eating the leaves of a variety of vines and young trees.

The woolly larvae of this species were taken in the fall as late as October 21. Pupae of this or a closely related species were found during the winter. They were common under loose

boards and trash by a roadside, March 2.

Isia isabella, Sm. and Abb.

This Arctiid is also mentioned by Forbes in the 23rd Report of the State Entomologist of Illinois (page 72). It differs from the preceding species in that the winter is passed in the larval stage.

The caterpillars were frequently seen during the fall crawling actively about along roadsides. January 28 one was seen under trash beside a rail fence. January 29 - a moderate day - numbers were noticed along a traction roadbed east of Urbana. Some were curled up on the cinders while others were crawling. Of specimens collected within a space of about 100 feet along the track 8 were dead and 12 were alive. Others were found April 2 under a corn shock and under boards. One brought into the laboratory had spun a cocoon by April 4.

Apantesis phalerata, Harr.

This species is discussed by Forbes in the 23rd Report of the State Entomologist of Illinois (page 76). It will feed on corn plants in confinement though it is most abundant in grass. It is two brooded, wintering as a partly grown caterpillar.

Arctiid larvae about 1/2 inch in length, which answered very closely to the description of this species, were found under trash by the roadside, March 2.

NEUROPTERA.

Chrysopidae.

Chrysopa oculata, Say.

Chrysopa usually winters as a pupa, according to Banks, (Trans. Am. Ent. Soc., Vol. 29, page 138) although C. plorabunda at least hibernates as an adult. C. oculata is mentioned as very common in the eastern United States in the adult stage from early July until September.

Adults were taken here as late as October 9.

Chrysopa plorabunda, Fitch.

This species is said by Banks to pass the winter as an adult, in which stage it has been found during January, February, and March in hedges and under heaps of dried leaves. It has been taken at Columbus Ohio in March and at the Agricultural College of Michigan in February.

The tender bodied adults were quite common January 27 under loose leaves along a rail fence and also throughout the woodlot nearby. On being uncovered they would fly a short distance but quickly settle back to the ground. They were active in the same woods the next day with the temperature slightly above freezing. They were again noticed in another woodlot, March 16.

Summary showing species and stages, places, and period of hibernation.

COLEOPTERA.

Carabidae.

Harpalus herbivagus.

Imago, in trash and under matted grass, Nov. 13-16.

Harpalus faunus.

Imago, underground, October 26-30.

Harpalus pennsylvanicus.

Imago, Oct. 28, in trash (Larva underground and imago under logs).

Callida punctata.

Imago, in trash and underground, Oct. 15-Nov. 6.

Agonoderus pallipes.

Imago, in rubbish and underground, Oct. 28-Nov. 30. Flying, Mar. 23.

Pterostichus sayi.

Imago, Oct. 13.

Pterostichus permundus.

Imago, Oct. 21.

Pterostichus femoralis.

Imago, under trash and leaves, Oct. 30, Dec. 4, Jan. 28.

Casnonia pennsylvanica.

Imago, under leaves, Mar. 16-24.

Anisodactylus rusticus.

Imago, Oct. 1.

Anisodactylus baltimorensis.

Imago, under leaves and matted grass, Mar. 24.

Anisodactylus harrisii.

Imago, among loose leaves, Oct. 21.

Anisodactylus lugubris.

Imago, under leaves, Nov. 3.

Galerita bicolor.

Imago hibernates underground. Common above ground in trash as late as Nov. 25.

Lebia viridipennis.

Imago, underground, Oct. 21.

Notiophilus aeneus.

Imago, under leaves, Feb. 2.

Amara musculus.

Imago, Oct. 30.

Amara cupreolata.

Imago, under leaves, Jan. 27-Mar. 16.

Amara pallipes.

Imago, under leaves, Mar. 18.

Tachys incurvus.

Imago, underground, Oct. 26.

Bembidium 4-maculatum.

Imago, under leaves and trash, Mar. 18.

Olisthopus micans.

Imago, underground, Oct. 26.

Platynus placidus.

Imago, under trash, March 2.

Calathus gregarius.

Imago, under leaves, Nov. 3.

Leptotrachelus dorsalis.

Imago, under leaves, March 16.

Staphylinidae.

Paederus littor~~ari~~eus.

Imago, common underground, under leaves, grass, and trash. Oct. 13-15-26, Nov. 26, Dec. 4, Mar. 3.

Sunius longiusculus.

Imago, under trash beside fences and hedges, Nov. 13-27, Mar. 18.

Stilicus dentatus.

Imago, under leaves, Nov. 27.

Actobius jucundus.

Imago, underground, Oct. 21.

Xantholinus sp.

Imago, in leaves and rubbish, Oct. 21, Mar. 24.

Tachyporus elegans.

Imago, under trash, Nov. 6, March 4.

Olophrum obtectum.

Imago, under matted grass, Oct. 16.

Phalacridae.

Eustilbus apicalis.

Imago, underground Oct. 21, above ground Nov. 26.

Eustilbus nitidus.

Imago, under loose earth and leaves, Oct. 15-19, Mar. 24.

Phalacrus politus.

Imago, beneath rail fence, March 5.

Corylophidae.

Orthoperus sp.

Imago, on bark of apple tree, Mar. 15.

Coccinellidae.

Megilla maculata.

Imago, gregarious under leaves especially beside osage orange hedges. Nov. 27 to March 4.

Hippodamia 13-punctata.

Imago, in sweepings Oct. 21, under leaves beside fences and hedges Nov. 3-6, March 24.

Hippodamia parenthesis.

Imago, active under matted grass and trash Jan 21, Mar. 2 and 24.

Scymnus americanus.

Imago, under rubbish, Nov. 13.

Coccinella 9-notata.

Imago, under matted grass Mar. 4, under leaves March 15, and on the wing Mar. 18.

Chilocorus bivulnerus.

Imago on bark of peach tree Mar. 8. Pair in copulation Mar. 17.

Cycloneda sanguinea.

Imago, under trash and in sweepings Nov. 3-6, Feb. 2 and March 17.

Anatis 15-punctata.

Imago, flying, April 4-5. Female depositing eggs April 7.

Erotylidae.

Languria mozardi.

Imago, underground Oct. 26, and under trash Nov. 13.

Languria angustata trifasciata.

Imago, under trash, Nov. 13.

Cucujidae.

Telephanus velox.

Imago, common under leaves and trash, Nov. 6. Jan. 28 - March 16-18-April 1.

Histeridae.

Hister americanus.

Imago, under leaves, Mar. 16.

Hister harrissii.

Imago, under leaves, Mar. 16.

Nitidulidae.

Epurea helvola.

Imago, in leaves beneath a rail fence Jan. 28, and March 5.

Trogositidae.

Tenebrioides corticalis.

Imago, under leaves and trash Nov. 3 and Mar. 16.

Lathridiidae.

Corticaria distinguenda.

Imago, in leaves and trash, Mar. 18.

Heteroceridae.

Heterocerus sp.

Imago, underground and in rubbish Oct. 26-30.

Elateridae.

Larvae, unidentified Mar. 3. Underground in a cornfield.

Melanotus communis.

Imago, under leaves and the bark of a fallen log, Nov. 3, March 2 and 18. Life cycle not less than three years.

Melanotus cribulosus.

Imago, underground in a cornfield, Dec. 3, Mar. 3.

Drasterius elegans.

Life cycle 2 yrs. Imago, common under boards, leaves, and trash throughout the winter from Nov. 13 to March 24.

Monocrepidius auritus.

Imago, under stone slab, April. 1.

Cryptohypnus obliquatalus.

Imago, underground, Nov. 3

Lampyridae.

Chauliognathus pennsylvanicus.

Larvae, under boards, chunks of rotting wood and trash, Mar. 2-17. Adults were seen as late as Oct. 9.

Cleridae.

Cymatodera balteata.

Imago, beneath an osage orange hedge, Nov. 6.

Scarabaeidae.

Ataenius cognatus.

Imago, under trash, and underground, Oct. 13 to 21,- March 23. Flying April 1.

Aphodius inquinatus.

Hibernates as larva and pupa. Imago, in flight Oct. to Nov. 27. In flight Mar. 4.

Aphodius serval.

Imago, in trash Mar. 1-16.

Onthophagus hecate.

Imago, under leaves and trash, March 16.

Balbocerus farctus.

Imago, in sweepings, Oct. 4.

Chrysomelidae.

Diabrotica longicornis.

Hibernates as egg. Imago from sweepings until October 21.

Diabrotica vittata.

Imago, in sweepings and under trash Oct. 30-Nov. 27, March 5-24.

Diabrotica 12-punctata.

Imago, in rubbish November to Dec. 4. In flight April 10.

Disonycha xanthomelaena.

Imago, under trash, Nov. 13.

Disonycha collata.

Imago, at the roots of blue grass, Dec. 4.

Oedionychis gibbitarsa.

Imago, from sweepings, under hedges, and beside fences. Oct. 13, Jan. 21-28, Feb. 2 and March 5.

Oedionychis thy amoides.

Imago, among leaves and underground, Oct. 12-15.

Myochrous denticollis.

Imago, in trash and underground, Oct. 26, Nov. 13.

Calligrapha similis.

Imago, underground and under blocks of wood, Oct. 26, to Dec. 4.

Labidomera clivicollis.

Imago, on Indian hemp, Oct. 9.

Lema trilineata.

Imago, underground Oct. 15.

Crepidodera longula.

Imago, underground, Oct. 21 - Nov. 3.

Crepidodera helxines.

Imago, on grass and weeds, in rubbish and underground Oct. 4, 21, and 30.

Chaetocnema denticulata.

Imago, under rubbish October 30.

Chaetocnema pulicaria.

Imago, in trash, Oct. 30.

Chaetocnema confinis.

Imago, common in trash as late as Nov. 13.

Haltica chalybea.

Imago, in flight, March 25.

Haltica bimarginata.

Imago, in flight, April 1.

Glyptina brunnea.

Imago, from sweeping, Oct. 7.

Typophorus canellus.

Imago, under trash, March 18.

Tenebrionidae.

Alobates pennsylvanicus.

Imago, under leaves, March 16.

Arrhenoplita bicornis.

Imago, from a fungus growth, Oct. 30.

Anthicidae.

Anthicus servinus.

Imago, in grass and under a hedge, Nov. 6 and Mar. 4.

Anthicus sp.

Imago, from grass and undertrash, Nov. 13, 20.

Anthicus formicarius.

Imago, underground and under rubbish, Oct. 26, Nov. 13.

Notoxus monodon.

Imago, very common under hedges and trash throughout the

winter. In flight April 9.

Otiorhynchidae.

Tanymecus confertus.

Imago, underground, Oct.26.

Phyxelis rigidus.

Imago, beneath a rail fence, March 5.

Curculionidae.

Apion sp.

Imago, from grass and under trash, Nov.6-13 and Mar.13-18.

Phytonomus punctatus.

Imago, Nov.20.

Smicronyx ovipennis.

Imago, under boards, March 2.

Lixus concavus.

Imago, in rubbish, Oct.30.

Rhyssematus palmicollis.

Imago, underground, Oct.26.

Rhyssematus lineaticollis.

Imago, larva and pupa in pods of milkweed Nov.13.

Baris aerea.

Imago, underground, Oct.21.

Baris confinis.

Imago, in underbrush, Oct.-Nov.13.

Calandridae.

Sphenophorus callosus.

Imago, underground, Oct.21.

HEMIPTERA

Emesidae.

Imago, in trash, Oct.26.

Reduviidae.

Melanolestes picipes.

Nymphs of various sizes, under trash, October and until Nov.13.

Nabis ferus.

Imago, very common under trash, throughout the winter.

Nabis punctipes.

Imago, under trash, throughout the winter.

Nabis rufusculus.

Imago, under leaves, Nov.3,6.

Nabis sp.

Imago, under tufts of grass, Dec.4.

Tingitidae.

Piesma cinerea.

Imago, common under trash and in fissures of bark, from Oct.15 to March 24.

Acanthidae.

Triphleps insidiosus.

Imago, in sweepings and in trash until Oct.21.

Capsidae.

Lygus pratensis.

Imago, very common throughout the fall and winter. Flying about on Mar.18.

Calocorus rapidus.

Imago, common on grass and clover, until Oct.26.

Lygaeidae.

Ischnodemus falicus.

Imago, on slough grass and under trash Oct.-Nov.13. Anymph as late as Oct.16.

Ligyrocoris constrictus.

Imago, from sweepings, Oct.9.

Oedancala dorsalis.

Imago, under leaves, Nov.3.

Geocoris uliginosus.

Imago, common under leaves, Oct.-Nov; Jan.27-28.

Microtoma carbonaria.

Imago, active among leaves, Mar.18.

Blissus leucopterus.

Imago, under trash beside fences and hedges, Nov.6, March 17-18.

Lygaeus kalmii.

Imago, in trash, October 28-Nov.20, Jan.28-29 to March 16.

Myodocha serripes.

Imago, common in rubbish and under leaves, during the fall and March 5-24. A nymph, Nov.20.

Pamera basalis.

Imago, in grass beside fences, Nov.26, March 18-24.

Berytidae.

Jalysus spinosus.

Imago and nymph, in grass and weeds, Oct.4 and 21.

Coreidae.

Alydus pilosulus.

Imago, on grass and under leaves, Oct.19, 26 and Nov.6.

Alydus conspersus.

Imago, from grass and clover, Oct.4.

Alydus eurimus.

Imago, in trash and leaves, Nov.6.

Catorhintha mendica.

Imago and nymph, on cockle bur, October 9. Imago in trash Oct.16, 26 and Nov.3.

Leptoglossus oppositus.

Imago, under leaves and trash, beside a fence, Nov.6.

Anasa tristis.

Imago, Oct.2 and 7.

Corisus lateralis.

Imago, common under matted grass and leaves throughout the fall and winter.

Pentatomidae.

Cosmopepla carnifex.

Imago, Oct.1 and 13 and Mar.18,

Coenus delius.

Imago, on grass and weeds and under trash, Oct.to Nov.20andDec4.

Podisus maculiventris.

Imago, on cockle bur Oct.9, in sweeping, Oct.30 and beneath leaves, March 2.

Euschistus variolarius.

Imago, common under leaves, as early as Oct.16 and until April 1. In flight Nov.27.

Murgantia histrionica.

Imago, under trash, Jan.25.

Mormidea lugens.

Imago, March 5.

Neottiglossa undulata.

Imago, under leaves, March 18.

Nezara hilaris.

Imago, under matted grass, March 2.

Peribalus limbolarius

Imago, common under leaves and trash beside hedges and fences, during fall and Mar.2-18.

Corimelaenidae.

Corimelaena pulicaria.

Imago, under leaves, Jan.28 and March2.

Corimelaena gillettei.

Imago, underground and under trash, Oct.21.

Corimelaena nitiduloides.

Imago, Oct.1.

Corimelaena unicolor.

Imago, underground and beneath trash, Oct.21,26 and 30and Mar.3

Fulgoridae.

Stobera tricarinata

Imago, during fall and Feb.2.

Stenocranus dorsalis.

Imago, from Oct.1 to Nov.26.

Jassoidea.

Deidrocephala mollipes.

Imago, common on grass until Nov.26. Nymph, Mar.18.

Gypona octolineata.

Imago, common on Indian hemp Oct.12, in flight Oct.30, and dead under leaves, Mar.24.

Acocephalus albifrons.

Imago, under trash, Nov.6 and in flight, December 4.

Phlepsius irroratus.

Imago, common in sweepings to Oct.15 and flying in swarms, Oct.9.

Agallia sanguinolenta.

Imago, common in trash throughout the winter.

Agallia 4-punctata.

Nymph, in trash, Nov.3.

Deltocephalus inimicus.

Imago, common in sweeping grass, until Oct.9.

Deltocephalus nigrifrons.

Imago, from sweepings, Oct.and Nov.6,13 and 26.

Deltocephalus affinis.

Imago, on grass, Nov.6.

Gnathodus punctatus

Imago, in flight, Nov.17.

Typhlocyba comes.

Imago, in flight Oct.30, and among loose leaves Jan.28and Mar.5.

Typhlocyba tricincta.

Imago, at roots of blue grass, Dec.4.

Typhlocyba hartii.

Imago, on bark of apple trees, Oct.21.

Typhlocyba vulnerata.

Imago, Oct.30.

Thamnottix melanogaster.

Imago, on grass, Nov.6.

Thamnotettix ciliata.

Imago, on grass, Nov.6.

ORTHOPTERA

Acrididae.

Tettigidea parvipennis pennata.

Imago, beneath trash, Oct.26,Nov.3 and Mar.2 and 16.

Tettigidea parvipennis.

Imago, under a block of wood, Dec.4 and out of shelter,April2.

Tettix ornatus.

Imago, in leaves, Oct.26.

Tettix ornatus triangularis.

Imago, under trash, Oct.26, Nov.3 and Dec.4.

Tettix sp.

Nymphs of Tettix, Oct.16 and Nov.13.

Chortophaga viridifasciata.

Nymph, in sweepings along roadsides and among trash, Oct.26 and 30, Nov.20 and Mar.16. Imago, April 2 and 10.

Locustidae.

Ceuthophilus sp.

Nymph, underground and in trash, Oct.21 and 30 and Nov.20.

Orchelimum or *Xiphidium sp.*

Nymph, in trash, Oct.9 and 21.

Gryllidae.

Ellipes minuta.

Imago, underground, Oct.15.

Gryllus sp.

Nymph, underground and beneath boards, Oct.15,Nov.3 and 27, Dec.3, and Mar.2.

Nemobius fasciatus.

Imago, in trash, Oct.16.

Nemobius carolinus.

Imago, under trash, Oct.30, and underground, Nov.3.

Blattidae.

Ischnoptera sp.

Nymph, under trash and under loose bark, Jan.28,Feb.2 and Mar.2.

DIPTERA

Tabanidae.

Tabanus atratus.

Larva, underground, Oct.12 and April 2.

Muscidae.

Pseudopyrellia cornicina.

Imago, under leaves, Jan.27 and Mar.2.

Oscinidae.

Elachiptera costata.

Imago, beneath fallen leaves, Feb.2.

Mycetophilidae.

Imago, under leaves, Jan.28.

HYMENOPTERA

Formicidae.

Camponotus fallax
subbarbatus
paucipilus

Imago,queen, worker and male, under bark,Feb.2.

Myrmicidae.

Cremastogaster lineolata.

Imago, winged female,male and worker,in block of wood,Nov.20.

Vespidae.

Vespa maculata.

Imago, in rotten log, April 2.

Vespa germanica.

Imago, under leaves, Jan. 28 and Mar. 1.

Ichneumonidae.

Imago, under leaves, Jan. 28.

Braconidae.

Imago, under leaves, Nov. 27 and 28, and Mar. 5.

LEPIDOPTERA.

Leucania unipuncta.

Larva, under matted grass, Oct. 13. Is known to hibernate as an imago also.

Noctua bicarnea.

Larva, under rubbish, Oct. 19 and Nov. 20 and 26.

Mamestra renigera.

Larva, under trash, Mar. 24.

The Diamond Backed Cutworm.

Larva, under trash, Nov. 26.

Arctiidae.

Diacrisia virginica.

Larva, beside roads, Oct. 21. Pupa, apparently of this species, Mar. 2.

Isia isabella.

Larva, beside road, Jan. 28, and 29. April 2. Pupated April 4.

Apantesis phalerata.

Larva, beside road and in grass, Mar. 2.

Neuroptera.

Chrysopidae.

Chrysopa oculata.

Imago, Oct. 9.

Chrysopa plorabunda.

Imago, among leaves, Jan 27 and Mar. 16.

Acknowledgements.

The present study of hibernation has been undertaken under the immediate direction of Dr. S. A. Forbes, to whom I am under obligation both for his interest and help during the progress of the work and for the revision of the manuscript.

I am also under obligation to Mr. C. A. Hart for his help in the determination of material and for many valuable suggestions.

Bibliography.

The following is a list of the articles which I have found most helpful in the study of insect hibernation. No attempt has been made to present a complete bibliography of the subject.

Aaron, S.F.

1902. Insects in winter. Scientific American, Vol. 86, p. 295.

Bachmetjew, P.

1901. Temperaturverhältnisse bei Insecten. Experimental Entomologische Studien. Vol. 1.

1907. Einfluss der äusseren Faktoren auf Insecten. Experimental Entomologische Studien. Vol. 2.

Blatchley, W.S.

1895. Notes on the winter insect fauna of Vigo Co., Indiana. A list of Orthoptera p. 247-250. A list of Coleoptera p. 336. A list of Hemiptera-Heteroptera, p. 267.

Bueno, J.R. de la torre

1903. A day's collecting in February. Canadian Entomologist, Vol. 35, p. 123-125.

Carpentier, L.

1899. Hivernage des Coléoptères. Bulletin de la Société Linneéne du Nord de la France, Vol. 14, p. 227-235.

Chittenden, F.H.

1899. Insects and the weather: observations during the season of 1899. Bull. 22, n.s. U.S.D.A.

Chittenden, F.H.

1901. Insects and the weather during the season of 1900. Bulletin 30, n.s. Div. of Entomology, U.S.D.A,

Cockle, J.W.

1905. Note on collecting hibernating specimens. Canadian Entomologist Vol. 37, p. 263-264.

Colthrup, C.W.

1899. Odonestes potatoria larva hibernating through two winters. The Entomologist, Vol. 33, p. 10.

Cook, A.J.

1881. Insects in winter. Psyche, Vol. 3, p. 183-185.

Davenport, C.B.

1897. Temperature limits of life. Acclimatization of organisms to extreme temperatures. Experimental Morphology, part 1, p. 231-258.

Fay, H.T.

1862. On winter collecting. Proceedings of the Entomological Society of Philadelphia, Vol. 5, p. 194.

Fyles, Thomas W.

1906. Winter retreats of insects. Canadian Entomologist Vol. 38, p. 137.

Hamilton, J.

1894. Hibernation of Coleoptera. Fort Worth, Florida. Canadian Entomologist, Vol. 26, p. 250-256.

Hinds, W.E. and yothers, W.W.

1909. The hibernation of the Mexican Cotton boll weevil. Bulletin 77 Bureau of Entomology. U.S.Dept. of Agriculture.

Kellog, V.L.

1904. Gregarious hibernation. Proceedings of the Entomological Society of London. 1904, p. 23-24.

Kirby, W. and Spence, W.

1823. On the hibernation and torpidity of insects. An Introduction to Entomology. Vol. 2, p. 430-465.

Lochhead, W.

1902. The hibernation of insects. Annual Report of the Entomological Society of Ontario. Vol. 32, p. 74-78.

Lyman, H.H.

1892. Can insects survive freezing? Canadian Entomolist. Vol. 24, p. 1.

Newell, W. and Dougherty, M.S.

1909. The hibernation of the Boll weevil in central Louisiana. Circular 31, State Crop Pest Commission of Louisiana.

Ormerod, E.A.

1879. Observations of the effects of low temperatures on larvae. Transactions of the Entomological Society of London. 1879, p. 127-130.

Osborn, H.

1894. Chinch bug note in Iowa. Insect Life, Vol. 7, p. 230-231.

Sanderson, E.D.

1907. Hibernation and development of the Cotton boll weevil. Bulletin 63, part 1, Bureau of Entomology. U.S.Dept. of Agriculture.

Sanderson, E.D.

1908. The relation of temperature to the hibernation of insects. Journal of Economic Entomology, Vol. 1, no. 1, p. 56-65.

Sanderson, E.D.

1908. The influence of minimum temperatures in limiting the northern distribution of insects. Journal of Economic Entomology. Vol. 1, no. 4, p. 245-262.

Sanderson, E.D.

1910. The relation of temperature to the growth of insects. Journal of Economic Entomology, Vol. 3, no. 2, p. 113-138.

Tower, W.L.

1906. Evolution in Chrysomelid beetles of the genus Leptinotarsa. Publications of the Carnegie Institution, No. 48.

Webster, F.M.

1898. The Chinch bug - including its hibernation. Bul., 15 n.s.Entomology, U.S.Dept. of Agriculture.

Webster, F.M.

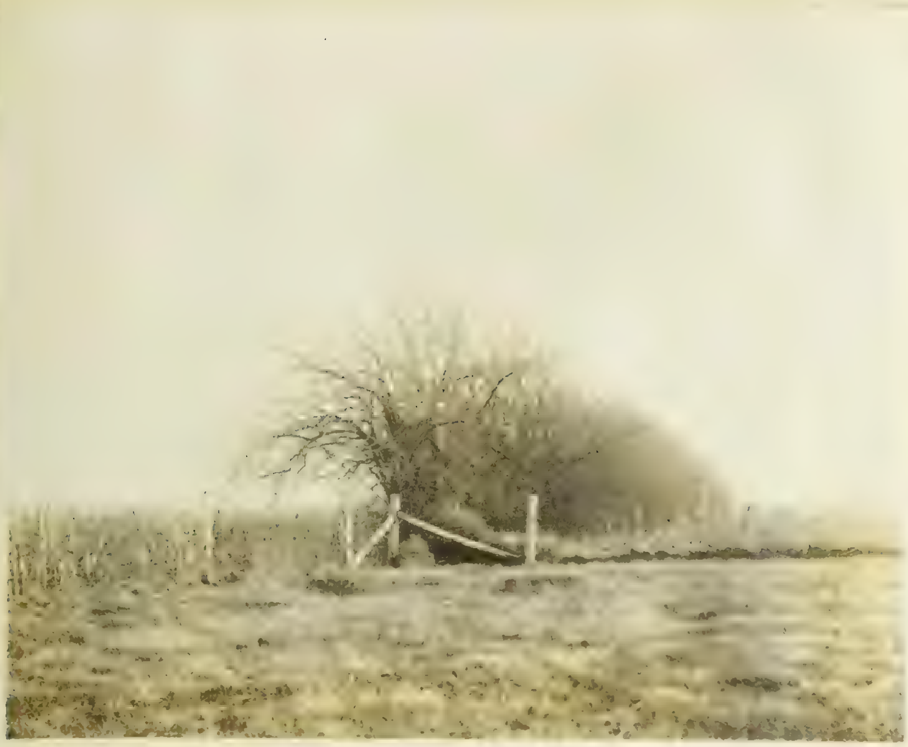
1908. Some things about insects that the grower of cereal and forage crops should know. Yearbook of the Dept. of Agriculture, 1908 p. 367.

Weed, C.M.

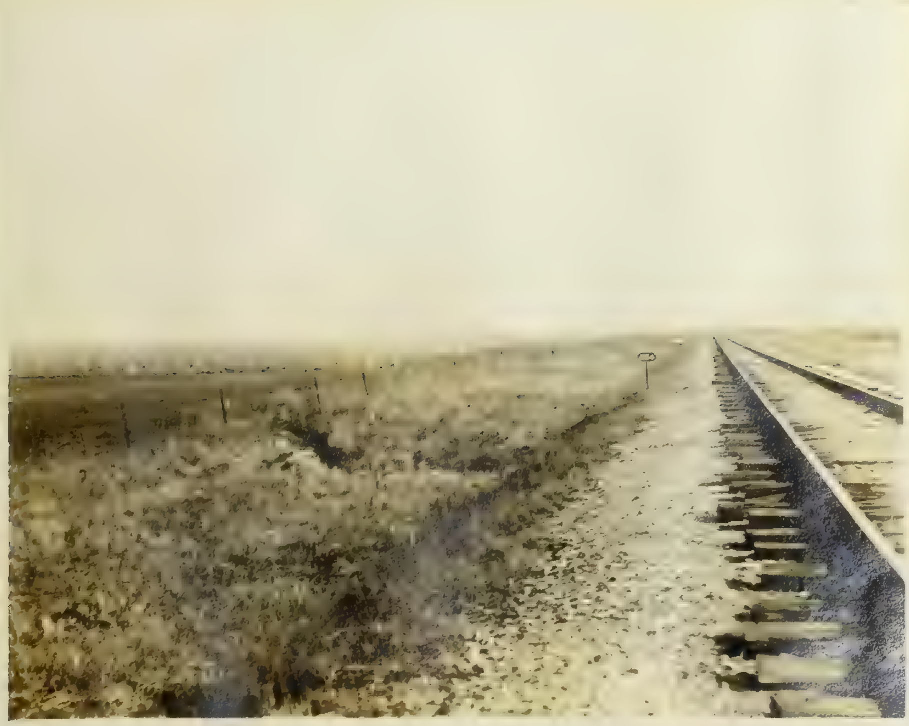
1896. The hibernation of aphids. Psyche Vol. 7, p. 349-362.

Wickham, H.F.

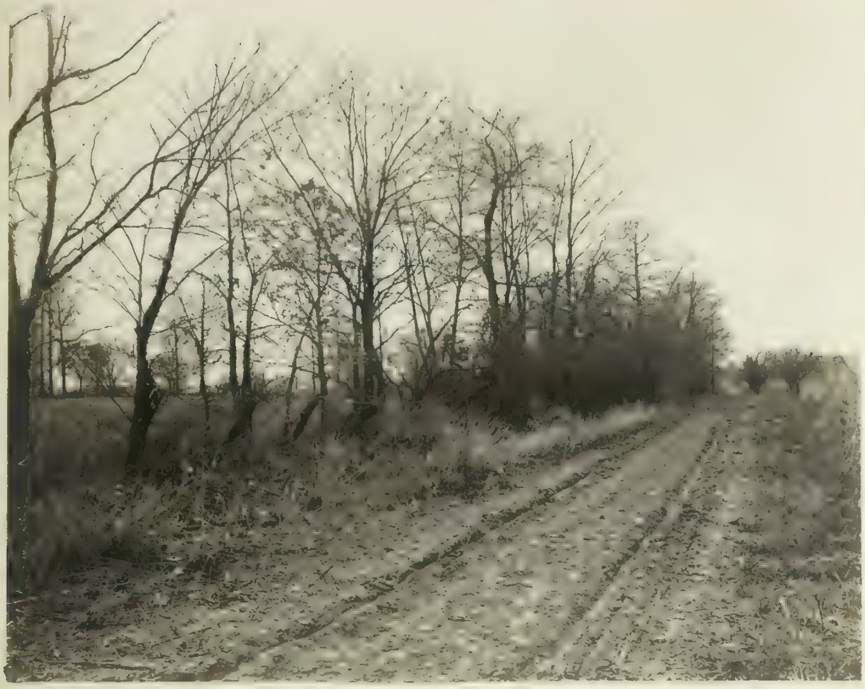
1892. Our winter beetles. Canadian Entomologist, Vol. 24, p. 99.



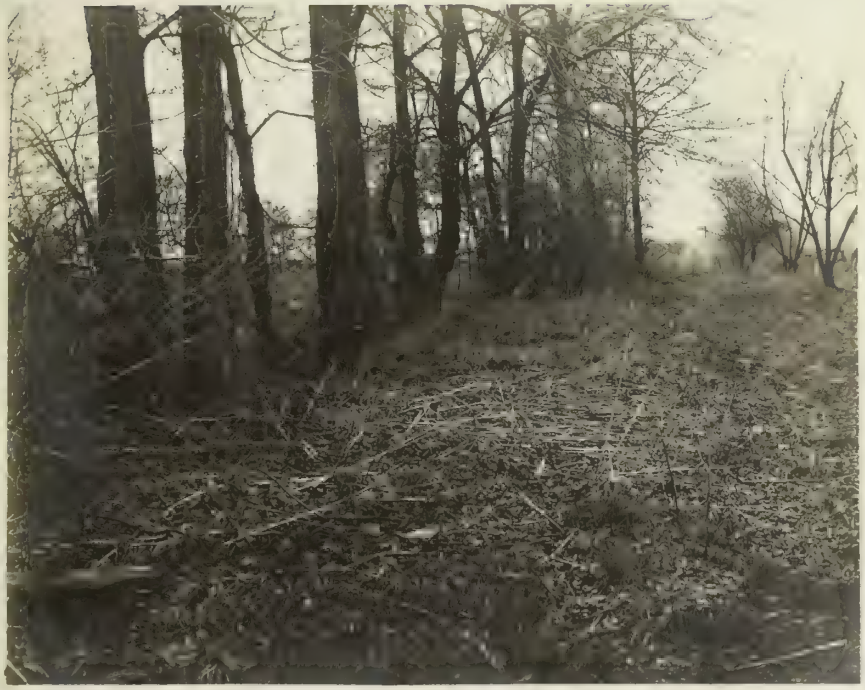
1 An Osage Orange hedge between cornfields.



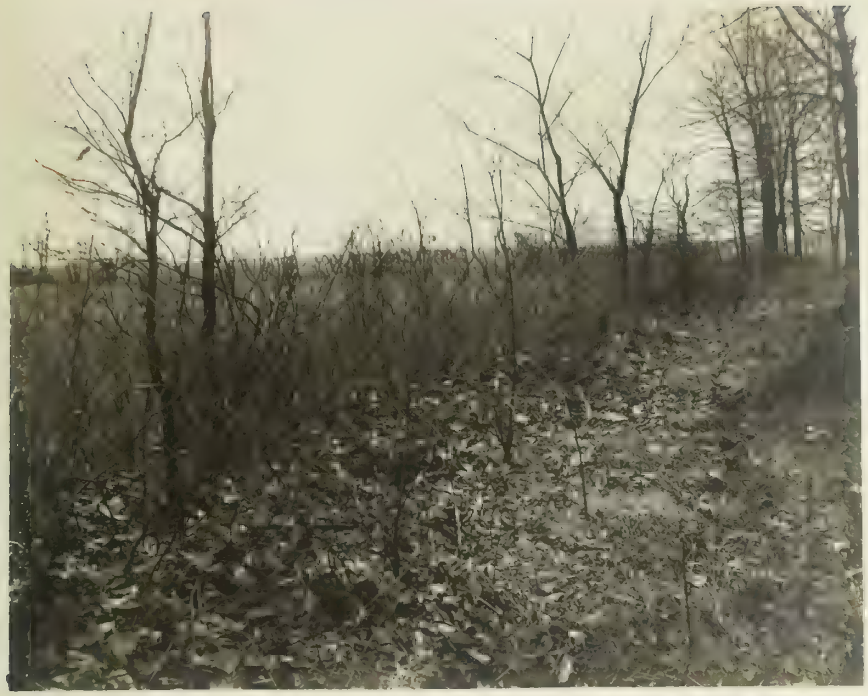
2 Headland along Big Four R. R. east of Urbana.



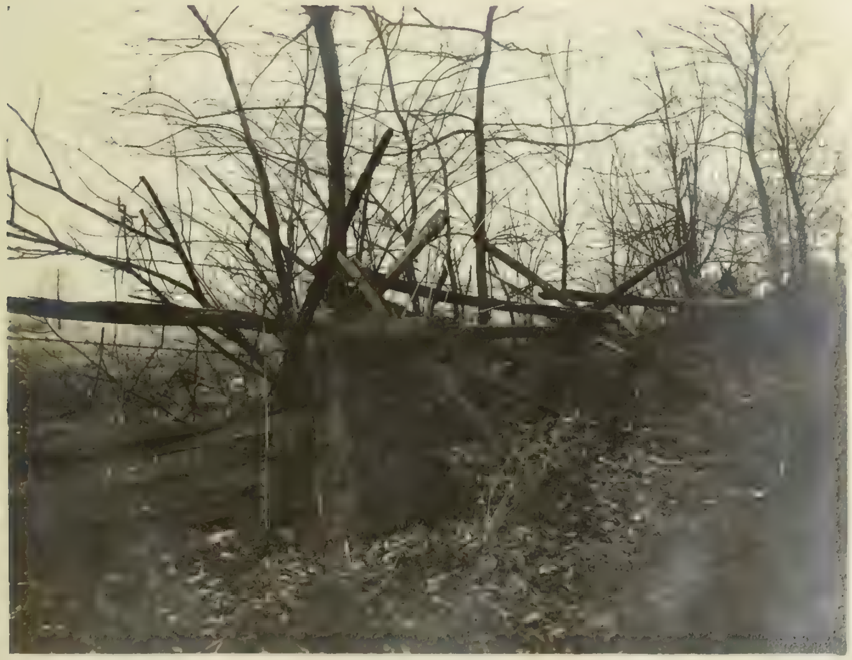
3 A neglected roadside.



4 A neglected roadside.



5 At the edge of a woodlot bordering a cornfield.



6 An old rail fence.

7 An osage orange hedge with trash and leaves.

8 An old cemetery.

UNIVERSITY OF ILLINOIS-URBANA
3 0112 082196723